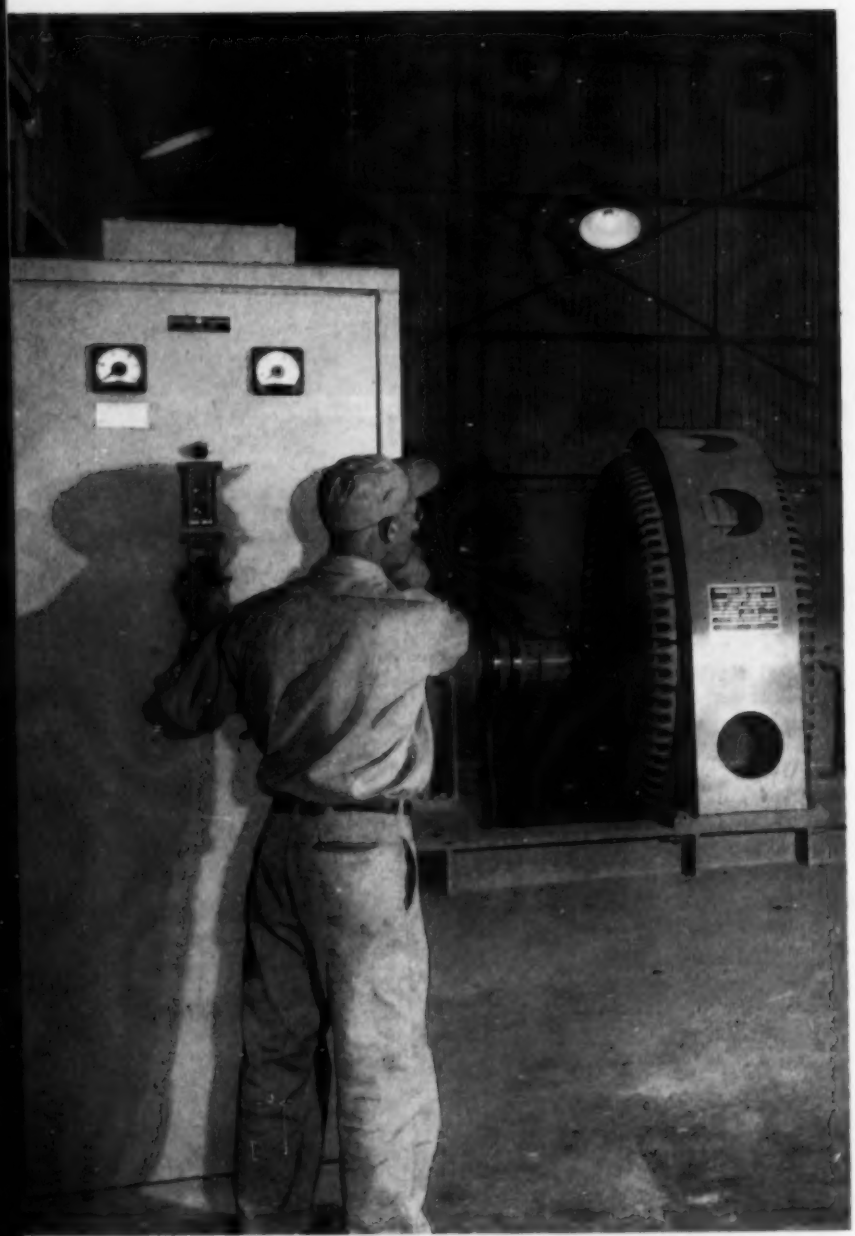
Industry and Power

November 1955



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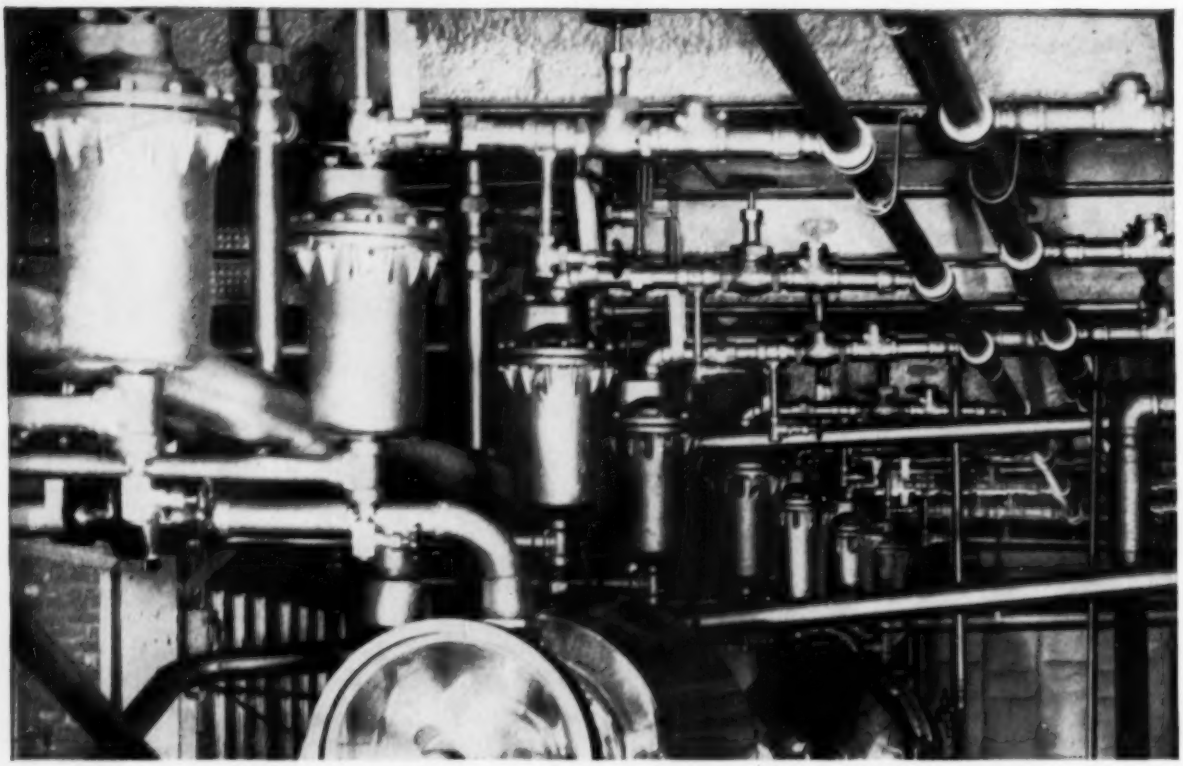

How To Increase Production and Still Use Less Fuel!

Problem—Cooking kettles at National Cranberry Company, South Hanson, Mass., couldn't produce enough to supply three recently speeded up canning lines. There was neither enough space nor steam supply capacity to add more kettles. Might there be another answer?

Solution—Mr. Russell Appling, Production Manager, made a very logical move, with everything to gain and nothing to lose. He called his local Armstrong Representative to talk about re-trapping his set-up. The existing traps were replaced with Armstrong 2" No. 216 large vent traps, one on each of the 8 kettles. Additionally, the steam lines were trapped to assure a dry steam supply.

Results—30% more kettle production. A fourth canning line was added to keep up with output. And, fuel consumption dropped 30% despite the production increase!

If you want more efficient production, greater return on equipment investment, why not call *your* Armstrong Representative. See your classified phone directory or Thomas Register, or write:

ARMSTRONG MACHINE WORKS
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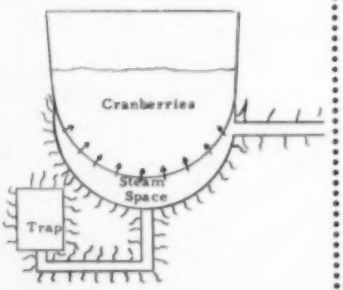
Ask for Steam Trap Book

ARMSTRONG STEAM TRAPS

HOW A KETTLE CAN GIVE 30% MORE OUTPUT WITH 30% LESS FUEL



Assume that with trap "X", inadequate for the job, cooking time is 10 minutes. During that period heat is radiating (wavy lines) from supply lines, kettle and trap. This non-productive heat loss wastes steam. Now, with an Armstrong trap keeping the steam space free of air and condensate, heat transfer rate is fast and cooking is done in 6 minutes. Thus, four minutes of non-productive radiation loss is eliminated—the faster cooking actually saves steam.

Circle 142 on READ-N-CIRCLE card for more data

next month in
INDUSTRY & POWER

what you should know about fuel oil additives

If you buy fuel oil, you should know what you're getting in addition to the oil itself. Additives are being used for many purposes, all of them important to intelligent buying.

Read all about these additives —what they are and what they do—in an article written by members of an independent chemical research firm. You will know more about the oil you buy after you read this article. Watch for it in

the December issue of INDUSTRY & POWER

---

you can still get
I&P's special report on

in-plant electric distribution

You should know about the trends that are constantly reshaping electrical practice in industrial plants. This comprehensive report offers a complete analysis of these trends in terms that apply directly to your problems.

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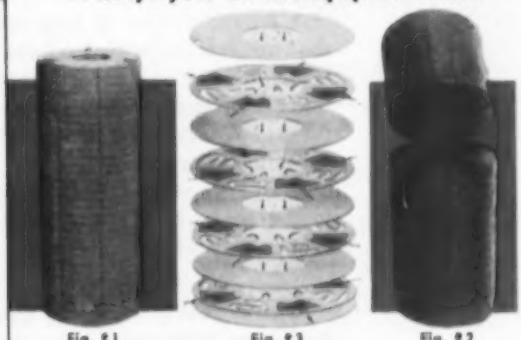

Fig. #1 Fig. #3 Fig. #2

HILCO FILTER CARTRIDGES

The result of much research in the field of lubricating, fuel and industrial oil filtration, the new patented HILCO Filter Cartridges meet the need for tremendous filtering area, low pressure drop and high dirt storage capacity. Above: Fig. 1 is a new cartridge; Fig. 2 is a used cartridge (note that pockets are completely filled and the outer surface covered with solids); Fig. 3 shows the flow of oil, the dark area represents dirty oil passing into the pockets while filtered oil (white area) passes into "S" shaped section.

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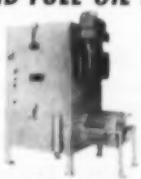

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this month's comment

. . . from industry & power

we can't be sure of anything. . . .

A friend of ours of long standing is fond of a conversational crutch that for him has withstood years of use. He says it this way: "The only thing you can be sure of is that you can't be sure of anything." Perhaps that's why engineers have come to be. No one can be quite sure of anything, so engineers are called upon to make the best choice among the educated guesses available. Now the reason we bring this up is that we have discovered an area of unsureness that most of us had long assigned to the realm of the "cut-and-dried." This area is the domain of fuels, particularly industrial fuels.

A good deal of money is already on the barrelhead for nuclear fuels. And some three years have passed since the first public utterances were heard to the effect that nuclear fuels would be but a *stopgap* between the days when fossil fuels run out and when direct conversion of solar energy becomes economically and technically practical.

Well, no one can expect the vested interests behind traditional fuels to take this talk lying down. We now hear of "the trend back to coal" and of reconversions from oil to coal. So any well-established trend in fuels —well-established in the minds of some, at least—is really not a trend we can be sure of. Certainly we cannot be dead sure in terms of the practical necessity of acting on our engineering responsibilities within the lifetimes allotted us.

We are not here to deny that progress is being made in the fuels picture, nor do we say that unsureness should slow our steps forward. But we do agree with many of the sobering voices that advise caution before commitment. They point out, for example, that the lifetimes of the power plants we build and use are becoming shorter—shorter in comparison to the length of days required for long-range trends to work themselves out soundly.

Consider first that we are doubling power consumption every ten years. Some segments of industry are doubling every seven years. There is sureness that this trend will not be arrested. The trend, in fact, is to force energy use to climb even more rapidly. This has the effect of making today's power producing and delivering equipment inadequate all the sooner. So we have the opportunity to expand and rebuild oftener and in greater quantity.

It might behoove us to plan today in terms of that which is sure for today, knowing that tomorrow will bring new opportunity to use that which will then be sure, sure for its day. For every day, the reign of sureness is indeed shrinking for all things.

Harold A. Bergen, Editor

The John Paul Taylor Publishing Co.
Commercial Bank Building, St. Joseph, Michigan

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nuclear news

. . . . about industry & power

BASIC PHILOSOPHY ON CIVILIAN POWER REACTORS

An AEC spokesman recently offered a four-point expression of AEC basic philosophy behind the civilian power reactor program: First, it is in the national interest to expand the present program in a manner which will accelerate the achievement of competitive nuclear power and improve the effectiveness of American assistance to other countries in the nuclear power field. Second, developing economically competitive nuclear power for civilian use will be aided by maximum practical utilization of financial incentive common to business ventures in order to stimulate ingenuity, imagination, and the assumption of calculated technical and economic risks. Third, the Commission's role should be to develop advanced technology at government expense and to stimulate outside groups to undertake developmental or demonstration power projects primarily with non-Commission financing. Fourth, positive steps of assistance to other countries should be included as part of the program.

SYNTHETIC NUCLEAR REACTORS FOR SALE

A nuclear reactor simulator assembly is now available to synthesize reactor operating conditions at a fraction of the cost of actual reactor operation. Leeds & Northrup are making the unit, which is based on a unique analog computor. A plastic model of a reactor core is included.

FORGING AHEAD ON THE NUCLEAR FRONT

J. Frederic Wiese, vice president of Lukens Steel, offered one of the most accurate descriptions of the temper of these nuclear times when he recently pointed out that those who do not choose to get their feet wet in nuclear energy may be taking as much of a risk as those who do participate. "For a business that refuses to take risks," he said "may some day find itself left far behind its competitors. . . ." On the day before this statement was made, Ebasco Services announced formation of an atomic energy division within its Engineering Department . . . . Informal observation of the crowds at the First Trade Fair of the Atomic Industry indicated that at least 25 percent of the people there had not partici-

LOW INITIAL COST and widespread reputation for dependability were the big reasons why The American Agricultural Chemical Company selected a Worthington vertical turbine pump. They use it to maintain proper storage level of their water supply lake in dry seasons.

Worthington vertical turbine pump supplements lake water in dry season

PHOSPHATE ROCK IS WASHED DOWN on flat screens to underwater trommels at American Agricultural. The Worthington vertical turbine pump ensures an adequate supply of water during the dry periods when the impounded rain water level in their supply lake gets low.

In Pierce, Florida, The American Agricultural Chemical Company mines phosphate rock for processing into fertilizers and other chemicals.

In washer operations at their South Pierce Mine, American Agricultural uses over 2,500,000 gallons of recirculated water every working day. All the water for this vast operation comes from various mined-out cuts and lakes. During the rainy season, water is impounded in these areas for use in the dry season. In abnormally dry seasons, however, American Agricultural supplements its water storage by using a modern Worthington vertical turbine pump.

Like American Agricultural, more and more industrial plants are turning to Worthington vertical turbine pumps as the most economical means of supplying water. Users everywhere praise the low maintenance and power costs of these dependable pumps.

Write today for our Vertical Turbine Pump Bulletin W-450-B-39. Worthington Corporation, Vertical Turbine Pump Division, Harrison, New Jersey.

4-32

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REPRESENTATION IN PRINCIPAL CITIES
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pated in any previous meetings in the nuclear field. . . . The Atomic Industrial Forum has experienced nearly a three-fold increase in membership in the past 14 months. Some 360 industrial, research, educational, labor, and government organizations now comprise its membership. All are either conducting or planning peacetime atomic energy activities.

TEST REACTOR TO KAISER

The AEC has signed a letter contract with Kaiser Engineers Division of Henry J. Kaiser Company for construction of an engineering test reactor. The project will start immediately, and will be done on a cost-plus-fixed-fee basis. Overall cost is estimated to be $15 million. The reactor will operate at a heat power level of 175 mw.

REVEAL DETAILS OF THERMONUCLEAR PROGRAM

Lewis L. Strauss, AEC chairman, took official wraps off of our research efforts in controlling thermonuclear reactions by announcing that programs are underway at Princeton University; Los Alamos; Livermore, California; Oak Ridge, Tennessee; and New York University. The long-range program has been underway since 1951. Admiral Strauss explained, "This fusion process can only occur at very high temperatures, in excess of 100 million degrees. The problem is to raise this material to such a temperature, to maintain it at that temperature, and to confine it for a sufficient length of time for enough of the nuclei to fuse, and then to extract the huge amounts of energy that are released from the fusion or in the course of fusion and to convert that energy directly or through some other process into electrical energy so it is usable."

FORESEE 1800-PSI NUCLEAR PLANTS

Experience gained in construction and operation of the atomic power plant being built for Commonwealth Edison in Chicago is expected to justify a boost from its planned 600 psi to 1800 psi in later reactors. The Commonwealth Edison plant, already the world's largest yet scheduled, is expected to have a thermal efficiency of 26 percent. The 1800-psi plant could achieve 32 percent thermal efficiency. General Electric, builder of the plant, says "In accordance with good teaching practice, we will learn by doing. We feel it is the responsibility of organizations such as ours to invest, to learn, and thereby hasten the day when atomic power can be practical and economical."

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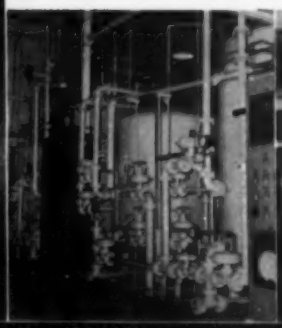
See the Cochrane Booth No. 197 at the Chicago Power Show Nov. 14-18

DEAERATOR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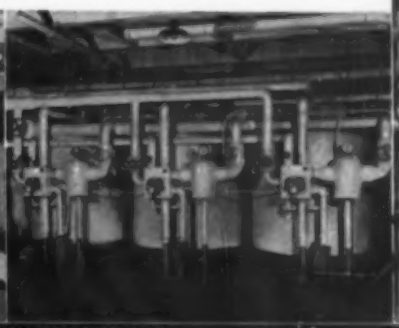
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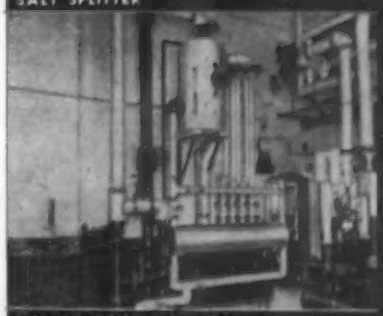
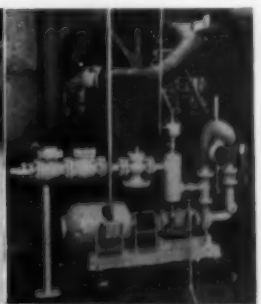

CONTINUOUS BLOW-OFF

STEAM PURIFIER

OIL SEPARATOR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new products

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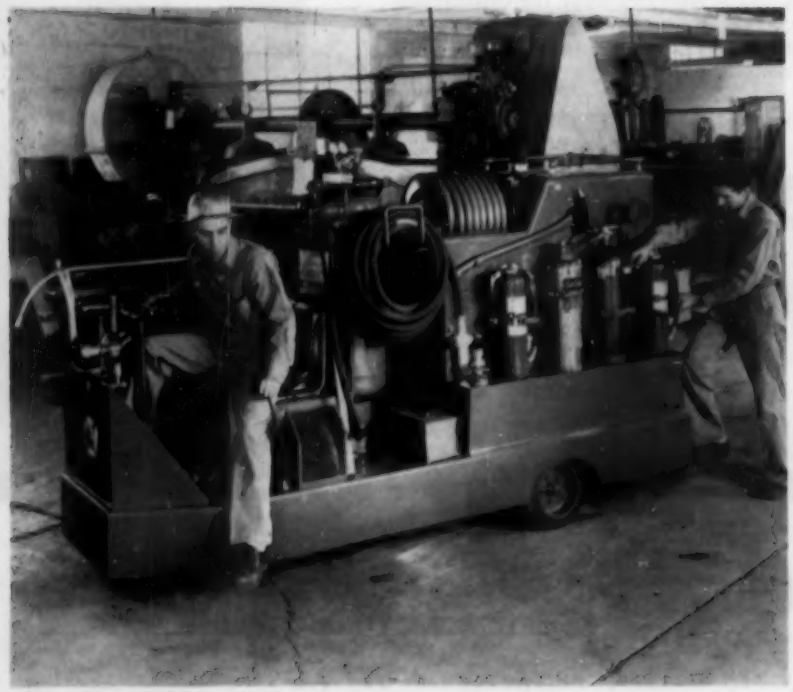
700-Versatile switching with new heavy-duty tractor unit

New heavy-duty Trackmobile hauls, switches, and spots railroad cars, operates on both road and track. When astride a track, the automotive-type pneumatic road wheels are retracted, allowing machine to rest on its steel rail wheels. Conversion from road to rail wheels takes only 90 seconds. After machine has been coupled to a car, a constant-pressure-type hydraulic jack on the unit lifts freight car slightly. Part of the car's weight is thus transferred onto the Trackmobile. This enables machine to develop as much as 12,800 pounds of draw-bar pull—sufficient to pull six fully loaded coal cars. All controls are located in cab. Cab is elevated and enclosed in glass to give 360° visibility for all-weather operation. Can be driven over unimproved tracks — crossing points not necessary. Unit can double as a road tractor inside the plant. WHITING CORPORATION.



701-In-plant fire truck carries fog and dry chemical

Easily maneuverable inplant fire trucks carrying a wide assortment of firefighting equipment are particularly adaptable to plant fire brigade needs. Trucks carry a 300-pound Ansul dry chemical unit, backed up by a 150-gallon water fog system. Also available with dry chemical-carbon dioxide, water fog-carbon dioxide combinations, or just water — depending on the hazards to be expected. Units are offered on either a three-wheeled, 42-inch wide chassis for inplant use, or on a four-wheeled 48-inch wide chassis with more road clearance and larger engine for indoor-outdoor use. Accessories include ladders, utility bar, lights, hose, portable fire extinguishers, and extra nozzles. All are mounted with panic-proof, quick release brackets. Accessory cabinet provides adequate storage room for fire blankets, boots, air masks, coats, and first-aid kits. Dry chemical unit is equipped with 100 feet of hose and a Dualstream nozzle. Water fog system pump is driven by power takeoff from

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BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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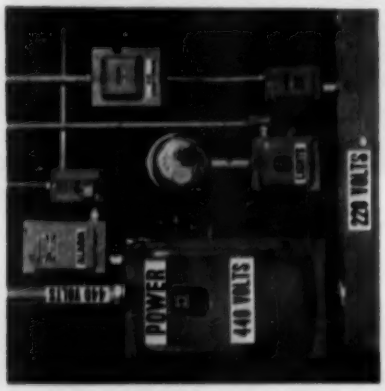
new products

. . . starts on page 10

the 14.6-hp Wisconsin engine that powers the truck. This gives 300 psi for good fog making and delivers 16 gpm. Flashing red light can be mounted on top of truck. Trucks are 10 feet long and less than six feet high. ANSUL CHEMICAL COMPANY.

702-Self-sticking conduit and voltage markers

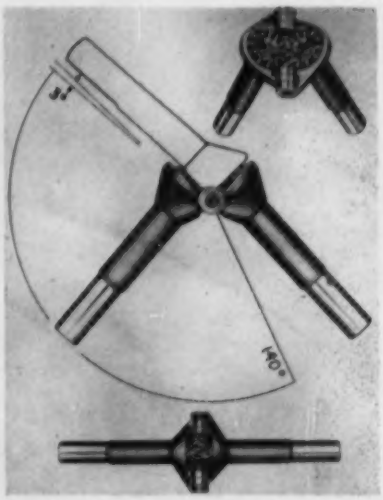
Self-sticking conduit and voltage markers can be used to identify all types of electrical equipment. Made of non-conductive cotton cloth with black lettering on orange background.



Can be applied in seconds and will stick permanently. Available in all NEMA voltages from 110 to 7200 volts and in names of the most common electrical circuits. W. H. BRADY CO.

703-Hinged gear point transmits power around corners

Hinged gear joint operates smoothly and efficiently where power must be angled to any position between 3 and 140 degrees away from a straight line. There is no need to shutoff power or reduce speed during swinging. When fully closed (axes are only three degrees from a straight line) all teeth are meshed. When fully open, four teeth are meshed. Suitable for out-of-line power transmissions up to ¼ hp at speeds not exceeding 1750 rpm. Available for use on 7/16-, ½-, and 9/16-inch shafts. Used in multiples of two or more, units provide an almost



unlimited assortment of power transmission possibilities. THE GRAY & PRIOR MACHINE COMPANY.

704-Free fuel oil desludger demonstration kit

Heavy fuel oil additive for Nos. 4, 5, and 6 fuel oil has an unusual gel-breaking detergent action. Desludgit breaks up oil-water gels, dissolves sludge, and emulsifies water in the oil. Fuel systems remain clean from tank to chimney because of better atomization when the additive is used. Free demonstration kit is available so you can perform your own tests and make

comparisons. Additive can be tried on a 30-day free trial offer. STEWART-HALL CHEMICAL CORPORATION.

FREE INFORMATION

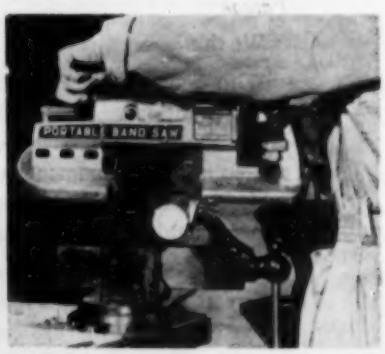
For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

705-Inhibited acid removes scale

Nonvolatile, nonhygroscopic, white crystalline solid inhibited acid safely and completely removes scale deposits from heat exchange equipment. DYNASOL 55 forms extremely soluble salts with calcium, magnesium, sodium, phosphate, and nonmetallic iron. Acid strength is equal to sulphuric acid. Available in 50- and 500-pound polyethylene-lined nonreturnable steel containers. CHEMICAL CLEANING SERVICE, INC.

706-Portable electric saw cuts problem materials

Portable electric band saw uses a new high-speed steel blade that makes



possible cutting most tough metals such as stainless steel, carbon tool steel, nickel, and high-speed tool steel. Although the Porta-Band Saw is not much larger than a hand hacksaw, it is 15 times faster and makes a cleaner, more accurate cut. Driven by a ½-hp motor, the band speed is 240 surface

(more new products on page 16)

YOUR NAME HERE*.....

may save you time and money ...keeps production UP

When industrial furnace enclosure repairs become necessary today, there's a lot of satisfaction in knowing that they can be made efficiently—and quickly—under the supervision of the company which designed those enclosures.

If you are fortunate enough to have Bigelow-Liptak furnace enclosures in your plant—the entire record of the installation; its description and lists of all repair parts are at the finger tips of our production department—ready to be used at a moment's call to help you get your furnace back in efficient operation in a minimum of time.

Experiences like the recent predicament of one of the major oil refineries prove the value of this Bigelow-Liptak feature. By means of comprehensive Trade Cards—that cover every Bigelow-Liptak installation from one end of the world to the other—recommendations were made over the telephone to this refinery which was having difficulties because war production during the last several years had forced operation to almost double its designed capacity. Necessary repair parts were indicated. A fully informed engineer was rushed to the job. And this aviation gasoline plant which had operated five years without repairs was back in service in four days at this greatly increased rating.

"Please accept our appreciation for the effort made to put this plant back in operation. It is nice to know we are dealing with companies and individuals who feel an interest and a responsibility in the jobs they have furnished," wrote the chief engineer of this great refinery. This is but one of dozens of recent tributes paid to the cooperation, engineering skill and efficient organization of Bigelow-Liptak. Your operation may depend not only on the design of the heat enclosure but the cooperation and efficient organization that backs it up.

* In the general office of Bigelow-Liptak

. . . there is a Trade Card that contains a detailed record of every installation. On this card will be found all of the data and information necessary and useful in servicing the job. Many of these cards are never referred to because Bigelow-Liptak enclosures are designed for long dependable service. But since furnace enclosures are the parts most subject to wear and tear, these records often become life savers for our customers.

When emergencies come we can quickly refer to any customer's Trade Card and find an accurate record of any installation. In a few minutes, with the aid of this information, we can set in motion the work that will enable him to get his furnace back in service in a minimum time. Your name on a Bigelow-Liptak Trade Card may save you money and invaluable time.

It will pay you to discuss your heat enclosure problem with Bigelow-Liptak—if you want enclosures that will give service and economy over a long continuous operating period. Get in touch with a Bigelow-Liptak engineer.

BIGELOW-LIPTAK *Corporation*

AND BIGELOW-LIPTAK EXPORT CORPORATION
2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MIAMI • MINNEAPOLIS • NEW YORK • PHILADELPHIA • PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • TULSA • MONTREAL • SAULT STE. MARIE, ONT. • VANCOUVER • WINNIPEG

Circle 141 on READ-N-CIRCLE card for more data

Paper Mills Choose for

WA-Series STEAM TURBINE GENERATOR UNITS

Produce Economical Plant Power as By-Product from Process Steam

At John Strange Paper Company

MENASHA, WISCONSIN

5000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of 150,000 lb per hour of process steam. Steam conditions at the turbine are 700 psig, 825 F, with 50 psig exhaust.

POWER SHOW — See Space 198 and 217, Chicago Coliseum, November 14-18.

ALLIS-

Allis-Chalmers Units Power Generation

The paper industry is a good example of many industries across the country that are choosing modern Allis-Chalmers WA-Series steam turbine generating units for plant power generation. Many installations are already operating in NEMA ratings from 2000 to 7500 kw. Recently, the line was extended to 16,500 kw in AIEE-ASME preferred ratings.

WA-Series units are available for condensing or non-condensing service, with or without automatic extraction, providing the kind of advanced design that power producers want. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets, and a time-proved governing system.

Engineered to Save Installation Costs

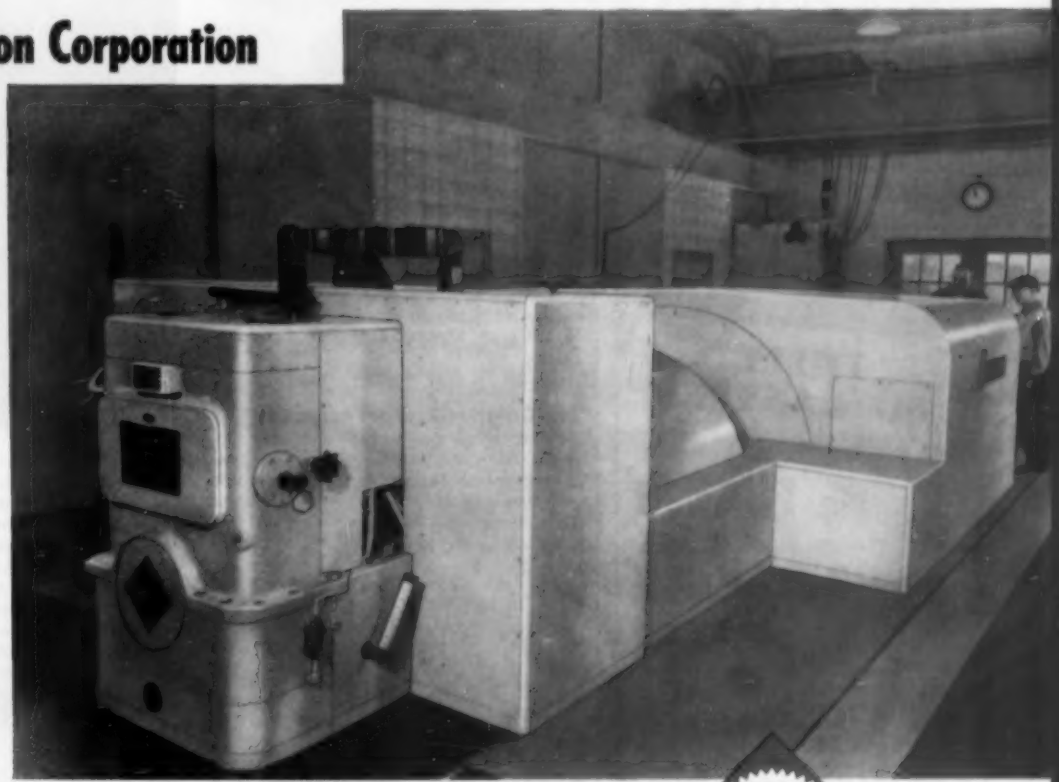
Particular care has been taken to promote ease of installation. Oil piping is above the floor line, eliminating need for trenches in the foundation. Generator gas coolers are located above the floor, eliminating ductwork through the foundation. Much of the work formerly done in the field is now performed in the factory. As a result, both turbine and generator can be shipped assembled ready for immediate installation.

For a detailed story on the advantages you can obtain with Allis-Chalmers steam turbine generating units, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 03B7654. A-4868

At Marathon Corporation

ROTHSCHILD, WISCONSIN

4000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of approximately 100,000 lb per hour of process steam. Steam conditions at turbine: 600 psig, 825 F, with 40 psig exhaust.



CHALMERS

A-C ALLIS-CHALMERS

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remember
in November,

POWER SHOW
is the place to go

space 198 and 217
CHICAGO COLISEUM
NOVEMBER 14-18

ALLIS-CHALMERS

A-4873

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Save on Your
INDUSTRIAL
TRACK

FULLY
GUARANTEED

FOSTER
QUALITY
RELAYING
RAILS

Lower installation and maintenance costs—handle more cars better. Foster nationwide warehouses also stock every New Rail Section 12# through 175#, Switch Material and Accessories to meet your specific job requirements.

SEND FOR CATALOGS IP-11

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L.B. FOSTER co.
PITTSBURGH 30 · NEW YORK 7 · CHICAGO 4
ATLANTA 8 · HOUSTON 2 · LOS ANGELES 5

Circle 131 on READ-N-CIRCLE card

new products

. . . starts on page 10

ft/min under load. Cuts within ⅝ inch of the ground can be made when working with conduit, cable, or pipe. PORTER-CABLE MACHINE COMPANY.

707-Turbine-type flowmeter has high accuracy

Precise flow rate measurements (± 0.5 percent of rate) up to 100,000 pounds per hour at specific gravity 1.0 is possible with this new flowmeter. Accuracy is not affected by piping configuration. Maximum pressure drop is seven psi. Meter has a fluid-driven rotor mounted in a short housing installed in pipeline. Rotor

blades are magnetic. As each blade passes a pickup coil, it induces an electrical pulse. Pulse frequency is fed into a converter to give a true rate indication. Specific gravity corrections are fed manually into a potentiometer, so that indicated flow rate is in mass flow units. Comes in standard sizes of ½ through 2 inches with maximum capacities from 9 to 210 gpm. FISCHER & PORTER COMPANY.

708-Color-coded grease caps

Color-coded grease caps not only improve lubrication procedure and maintenance control, they also prevent dirt and grit that gathers around grease nipples from being forced into bearings and bushings by the grease gun. Color coding

immediately shows correct type of grease required for each nipple. These tight-fitting caps molded of Bakelite polyethylene, can be reused indefinitely. Have withstood US Navy and Marine Corps testing over a temperature range of -40 to 200 F. Caps are so inexpensive that they can be used to protect grease fittings while painting, sandblasting, assembling, or storing equipment. BAKELITE COMPANY, DIVISION OF UNION CARBIDE AND CARBON CORPORATION.

709-Control center scans work

New control center automatically checks temperatures at each control station in a fixed time interval (72 stations in less than four minutes). Should any station be off limits, visual and audible alarm is given. Amount of correction re-

quired is indicated. Observer may reset the instrument controlling the processes right from the control center. Nonindicating electronic-type controllers are small, compact plug-in units with a resistance thermometer-type sensing circuit. Manual reset switch clears alarm indication after temperature corrections have been made. Manual pushbutton switch enables operator to manually check any temperature point. WHEELCO INSTRUMENT DIVISION, BARBER-COLMAN CO.

710-Pen-sized radiation dosimeter is inexpensive

Major exposure dosimeter for instant detection and visible warning of dangerous exposure to radiation provides both cumulative measurement and instantaneous reading. Polystyrene beads are contained in a hollow hermetically-seal-

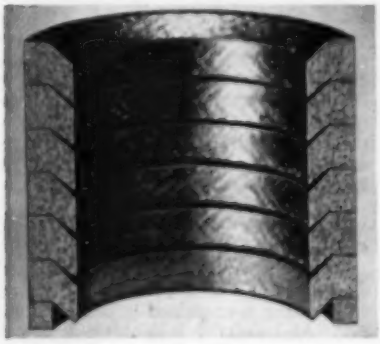
ed ionization chamber. When charged by simple shaking, beads adhere to the top and sides of tube. After exposure to a precalibrated amount of radiation, they are discharged and fall to the bottom. Will detect 50 Roentgen's exposure (1/8 of the amount of radiation that the average person can withstand). It has unlimited life with normal usage. ELECTROMATION CO.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

711-Special packing for soot blowers

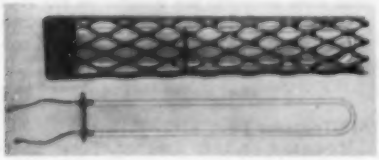
Special packing for soot blowers is made of asbestos yarn braided over a plastic core of heat-resistant composition, then lubricated with mica or graphite. Combination of lip-type and solid packing is arranged so that solid part takes gland pressure. Lips are then free to act upon pipe or tube. When actuated by fluid pressure, lips provide a



tight seal with minimum friction. Packing withstands high-pressure superheated steam without hardening, drying out, or vulcanizing. It is sturdy enough to act as a bearing when needed. Available in sizes to fit stuffing boxes of practically every soot blower. JOHNS-MANVILLE.

712-New quartz immersion heater

Electric radiant translucent fused quartz immersion heater solves the problem of heating corrosive chemicals. Unit

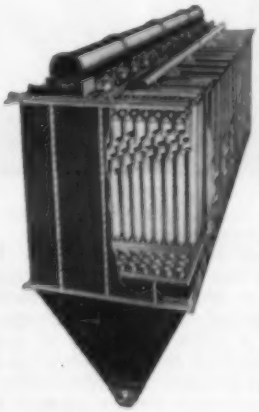


heats instantly, has a 100-percent short-proof construction, and has thermal construction that gives greater accuracy and longer life. More wattage is attainable

(more new products on page 96)

That's the guarantee you get with **Norblo** Automatic Bag Type Arresters

By "constant" we mean what operating men *expect* it to mean when applied to dust collection — *no* loss of suction drop, *no* down time, *no* variation in capacity.



Norblo's unit compartment system, with automatically controlled progressive and cyclic bag cleaning maintains the full capacity for which the particular installation is engineered. Bag cleaning is easily regulated if dust loading rate should change. Only one compartment is cut out at a time for cleaning (and that for only a few seconds) by means of moderate shaking which insures long bag life. A small quantity of reverse air is used to prevent unwanted dust flow during shaking operation. Excess dust is dropped without destroying the desirable basic filter cake.

Profitable, consistent performance of Norblo automatic dust and fume collection equipment is demonstrated in hundreds of important installations. If you need this facility for production, for salvage, or for good housekeeping, ask Norblo engineers what they can do for you. Write for Bulletin 164-A.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6422 Barberton Ave. OLympic 1-1300 Cleveland 2, Ohio

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new bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 83

400-Get instrument-quality air

Bulletin M-7155 tells how to remove moisture, oil, and dirt from your compressed air system. Equipment features a radial fin disposable filter cartridge. Four pages. HANKISON CORPORATION.

401-Immersion heater data charts

Electric immersion heating elements for industrial, commercial, and domestic use are described in Bulletin EC-53. Contains data charts, descriptive material, and total wattage requirements for heating of solids, liquids, or gases. List of custom-made heaters is included for special problems. Twenty-six pages. CUTLER-HAMMER, INC.

402-Plate-fin heat exchanger

Illustrations and text in this bulletin describe how the use of an improved brazing alloy and application techniques improves corrosion resistance at high temperatures. Photomicrographs are included to show oxidation and aqueous corrosion tests of a typical brazed joint. Eight pages. THE GRISCOM-RUSSELL COMPANY.

403-Tables for magnetic starters

Small-size magnetic starters for air conditioning and refrigeration installations are included in Bulletin GEA-6301. These 20 to 30 ampere starters feature automatic reset, simple wiring, mounting interchangeability, and attractive appearance. Tables for the selection of quick-trip overload relays and overload heaters are also included. Eight pages. GENERAL ELECTRIC COMPANY.

404-Lessons in arc welding

A series of practical exercises and instructions for developing and improving the technique of arc welding operators is contained in this book. Text includes starting and manipulating the arc, welding common joints with bare electrodes, welding light-gauge sheets with coated electrodes, general welding with coated electrodes, pipe welding, welding cast iron, and special practices and tests. Price: $1.00 per copy. Two hundred pages. HOBART TRADE SCHOOL, INC.

405-Plastic skin for buildings

Technique of spraying pure liquid vinyl plastic on building surfaces to form a pliable sheeting of high tensile strength and elongation is discussed in Bulletin 24-B. Plastic spray can be used under conditions of high humidity, salt air, or corrosive atmosphere. Four pages. LIQUID PLASTICS CORPORATION.

406-Build with stainless steel

Information on how to reduce erection costs while maintaining insulating values is contained in Bulletin 70-5. Stainless steel siding can be used over old masonry, wood, or steel walls to upgrade old buildings. Four pages. JOSEPH T. RYERSON & SON, INC.

407-Corrugated flexible metal hose

Complete engineering data including bending radii, bursting pressures, and weights, are included in Bulletin 20-E. Applications are listed for absorbing vibration, correcting misalignment, connecting oil burner and gas furnaces, lubricating lines, and conveying compressed air and steam. THE ATLANTIC METAL HOSE CO.

408-Hose and couplings data

Bulletin 3040-A explains how high-pressure hose assemblies can be quickly made with reusable couplings. Reusable couplings reduce costly inventories and provide a quick, easy way of making hose assemblies for replacement and installation purposes on hydraulically operated equipment. Twelve pages. THE IMPERIAL BRASS MANUFACTURING CO.

409-Electronic speed control manual

Illustrations and circuit diagrams describe in nontechnical simplified language the installation, performance, and maintenance of the basic Dynamatic electronic control. Also describes principles used to accomplish stepless speed control using an ac line as the power source. Sixteen pages. DYNAMATIC DIVISION, EATON MANUFACTURING COMPANY.

410-Versatile power control

Theory and application of saturable reactors as control equipment for individual power loads is discussed in illustrated Bulletin GEA-6354. General points discussed are control of electrically-heated equipment, automatic temperature stabilization, reduced-voltage motor starting, continuously adjustable reactive load banks, and X-ray equipment. Eight pages. GENERAL ELECTRIC COMPANY.

411-Accurate valve sizing manual

Comprehensive and easy-to-understand discussion of the importance of proper valve sizing is contained in Bulletin 120-2-55. Also contains formulae and nomographs for sizing valves to meet any conditions of steam, liquid, and gas flow. Additional tables of flow coefficients for the many configurations of diaphragm-control inner valves are also given. Twenty-four pages. BLACK, SIVALLS & BRYSON, INC.

412-Lightweight steel decking

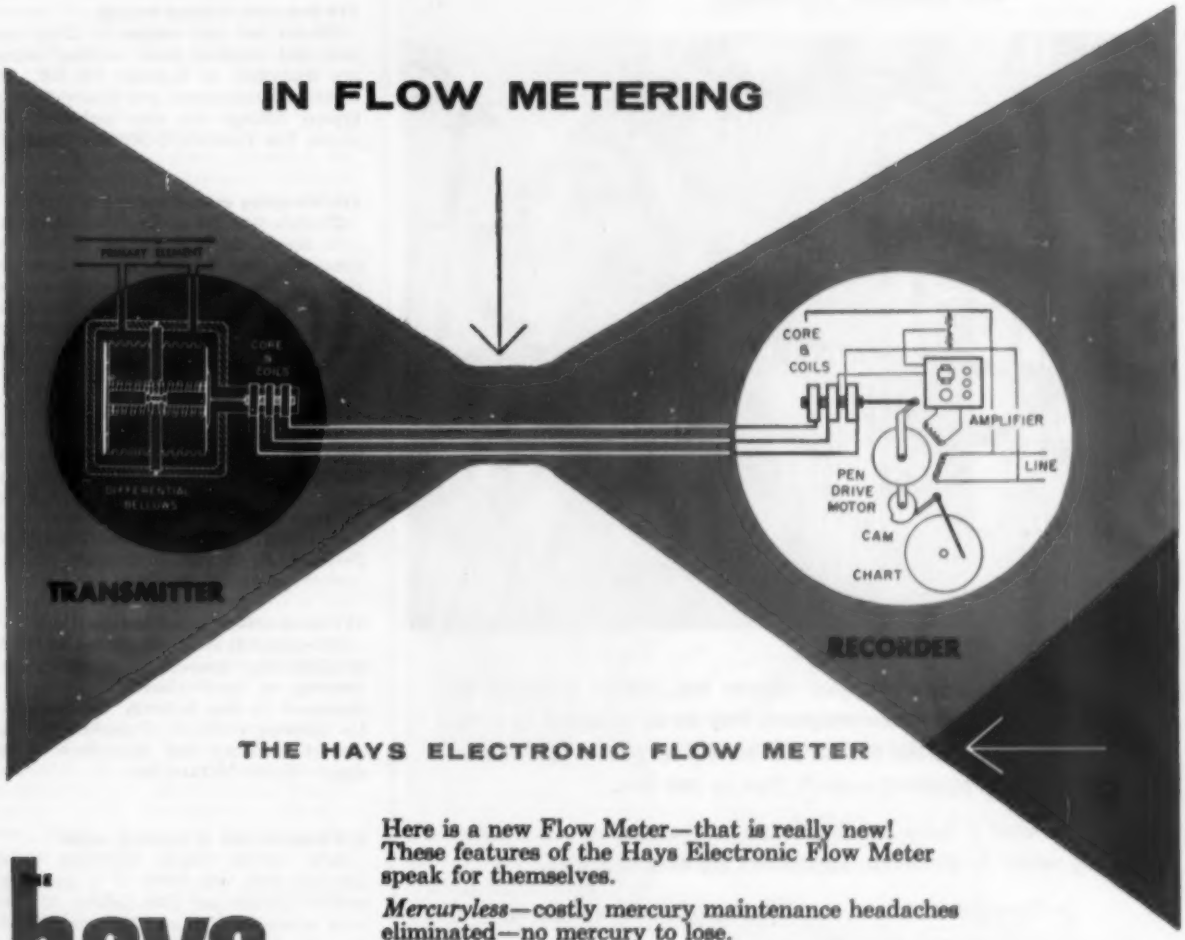
Descriptive material on lightweight steel decking contained in Bulletin 2d-Am includes types available, safe load tables, erection details, and welding specifications. Lightweight, fire-resistant ribbed steel sections are adaptable for roof, sidewalls, subflooring, and partitions. Four pages. AMERICAN STEEL BAND COMPANY.

413-Transfer heat with synthetics

Recommended uses of Ucon heat-transfer fluids are contained in Bulletin F-7490C. Ucon fluids have resistance to forming sludge, varnish, or coke. They will withstand temperatures of 500 F. Fluids have good low-temperature viscosity characteristics, low stable pour points, negligible solvent and swelling

new dimensions

IN FLOW METERING



THE HAYS ELECTRONIC FLOW METER

hays
CORPORATION
MICHIGAN CITY 2, INDIANA

Automatic Combustion Control • Varidraw Meters and Varitrol • Electronic Oxygen Recorders • CO₂ Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

Here is a new Flow Meter—that is really new! These features of the Hays Electronic Flow Meter speak for themselves.

Mercuryless—costly mercury maintenance headaches eliminated—no mercury to lose.

Rupture-proof Bellows—provide positive protection against over-range.

Continuous integration—motor-driven continuous mechanical integrator is extremely accurate even on rapid load changes.

Electronic operation—requires only 4 seconds for full scale pen travel with accuracy of ¼% of full scale differential.

Other features include null-balance transmission, powerful motor, easy readability, accuracy unaffected by normal temperature changes. Explosion proof transmitters and wide range meters also available.

For complete information, write for Bulletin 54-1074-222.

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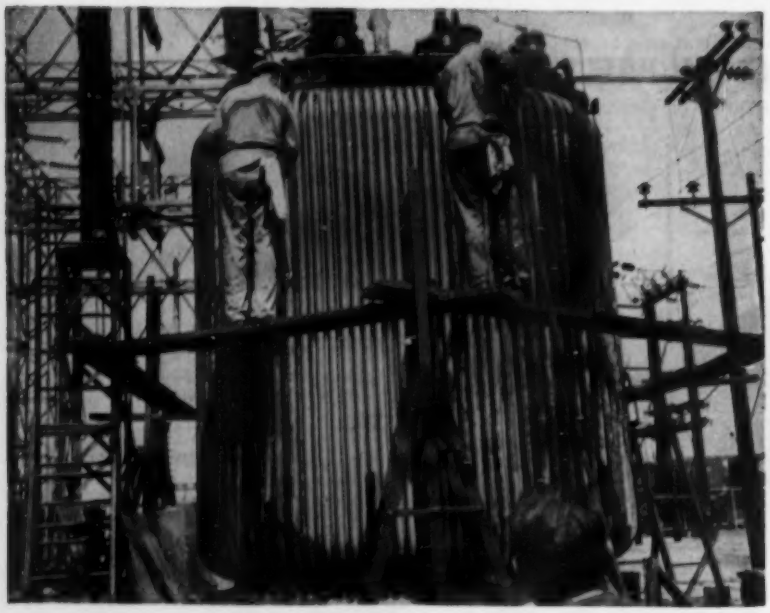
SUBOX guards all three!

STRUCTURES
EQUIPMENT
FENCES

with maximum protection
and minimum application



• Subox paints assure both good radiation and excellent protection for transformers and sub-station equipment. They are easily applied by brush, spray or flow-coating. Use them on your present equipment—specify them on your present equipment—specify them on your new.

• All varieties of Subox and Subalox can now be supplied with a faster-drying vehicle for distribution transformers and other shop work.

• Sub-station structures can often be painted with a single coat and a minimum of outages.

• Industrial-type fences can be amply protected with one coat applied by floor brooms.

Write For A Free Copy of "Corrosion Control of Electrical Structures and Equipment"

Subox Inc.

9 Fairmount Plant, Hackensack, N. J.

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new bulletins

. . . starts on page 18

effects on natural and synthetic rubber, and are noncorrosive to copper and other common metals of construction. Four pages. UNION CARBIDE AND CARBON CORPORATION.

414-Seamless welding fittings

Grades and size ranges of alloy, carbon, and stainless steel welding fittings are contained in Bulletin FB-500. Dimensional tolerances and illustrations of typical fittings are also included. Six pages. THE BABCOCK & WILCOX COMPANY.

415-Weighing errors are costly

Cumulative cost of small weighing errors over definite periods of time is clearly shown in this leaflet. Contains chart of interest to all who buy or sell merchandise on a weight basis. NATIONAL ASSOCIATION OF SCALE MANUFACTURERS, INC.

416-Selecting the right wire rope

Recommendations for the proper material, lay, and construction of wire rope for the majority of average-use conditions are included in Bulletin 28. A helpful bulletin for all Power Services engineers. Six pages. LESCHEN WIRE ROPE DIVISION, H. K. PORTER COMPANY.

417-Hardsurfacing recommendations

Development and manufacture of binder alloys plus procedures to obtain best bonding of hardsurfacing deposits are discussed in this bulletin. Includes table showing methods of application and correct welding rod diameters. Four pages. COAST METALS, INC.

418-Remove rust in drinking water

New service treats incoming water supplies with one-tenth of a pound of sodium silicate per 1000 gallons to prevent corrosion of lines. Bulletin CS-101 explains how this service prevents the destruction of piping and reduces maintenance and replacement costs. THE PERMUTIT COMPANY.

419-Handbook of hydraulic tables

This comprehensive reference work is now available for engineers interested in pumping and piping problems. Bulletin 50 also contains data useful to all engineers. Twenty-eight pages. THE ALDRICH PUMP COMPANY.

420-Low-cost interrupter switch

Applications for disconnecting switches to safely open plant primary circuits under moderate load are contained in

Bulletin 33-B. The Delta-Star type SL interrupter switch operates on opened-circuit current up to 400 amperes at 15 kv with safety. Dimension drawings and illustrations are also contained. Six pages. DELTA-STAR ELECTRIC DIVISION, H. K. PORTER COMPANY.

421-Rubber lining combats corrosion

Fully revolving double-disc parallel-feed gate valve lined with special hard-rubber lining is described in this bulletin. Revolving disc principle distributes wear over 360 degrees. Included are dimension drawings for both rubber-lined gate valves and swing check valves. Four pages. DARLING VALVE & MANUFACTURING CO.

422-How to pump additives

How to pump petroleum, chemical, and boiler feed water additives in accurate predetermined quantities is discussed in Bulletin 1105-2. This bulletin contains pumping capacity tables and schematic diagrams of typical applications. PROPORTIONEERS, INC.

423-Renew worn cylinder walls

Patented process of honing and chrome plating worn cylinder walls is illustrated in this bulletin. Processed cylinder liners outlast cast iron liners three to five times. Four pages. VAN DER HORST CORPORATION OF AMERICA.

424-Regulating valves are automatic

Bulletin 4 contains sections on float and lever valves, pump governors, pressure regulators, vacuum breakers, and strainers. Illustrations show typical installations and operation of equipment. Four pages. SCHADE VALVE MANUFACTURING CO.

425-Complete control valve manual

Manual No. 14 contains illustrations, dimension drawings, and recommended installations for valves in sizes from ⅛ inch to 1 inch. Descriptive material on two-, three-, four-, and five-way valves is also included. Control-system valves may be solenoid, pilot, cam, foot, or hand actuated. Eight pages. VERSA PRODUCTS COMPANY.

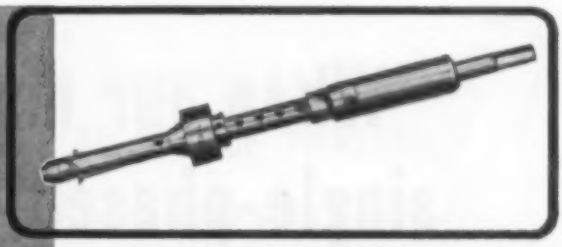
FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

426-Heating large volumes of water?

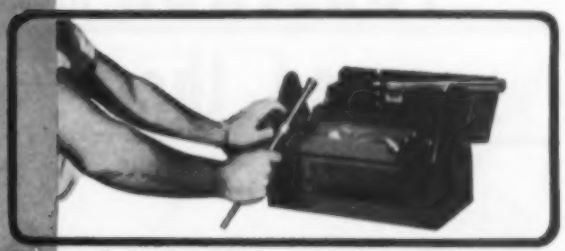
Problems involved in heating large volumes of water are explained in Bulletin 923. This bulletin discusses the advantages, including fuel saving, of new type of water storage over conventional storage system. FRED H. SCHAUB ENGINEERING CO.

(more new bulletins on page 24)



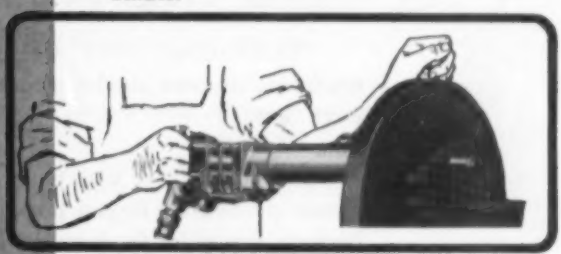
Now—a new push-type internal Tube Cutter

A time-saving maintenance tool that may be used with your present air or electric motor to cut non-ferrous tubes.



Easily carried. A must in every tool box.

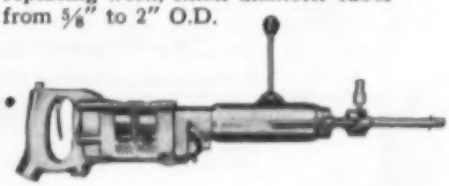
Many uses in every plant. Action of cutting blades is produced by pushing cutter into the tube which automatically opens the double cutter blades.



Works wonders when replacing tubes

Extremely useful. Saves time when replacing worn, small diameter tubes from ⅝" to 2" O.D.

Also furnished with motor and lever operator



An air-driven type internal tube cutter is available for production use. Cuts non-ferrous tubes 2-4 seconds each. Steel tubes 8-12 seconds each. Literature and complete details upon request.

BRANCH OFFICES: New York, Chicago, Philadelphia, Tulsa, Houston, Baton Rouge.

Representatives in principal cities of U.S.A., Canada, Mexico, England, South America and Japan.

EUROPEAN PLANT: Airetool Nederland, N.V., Vlaardingen, The Netherlands.

"There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction."

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

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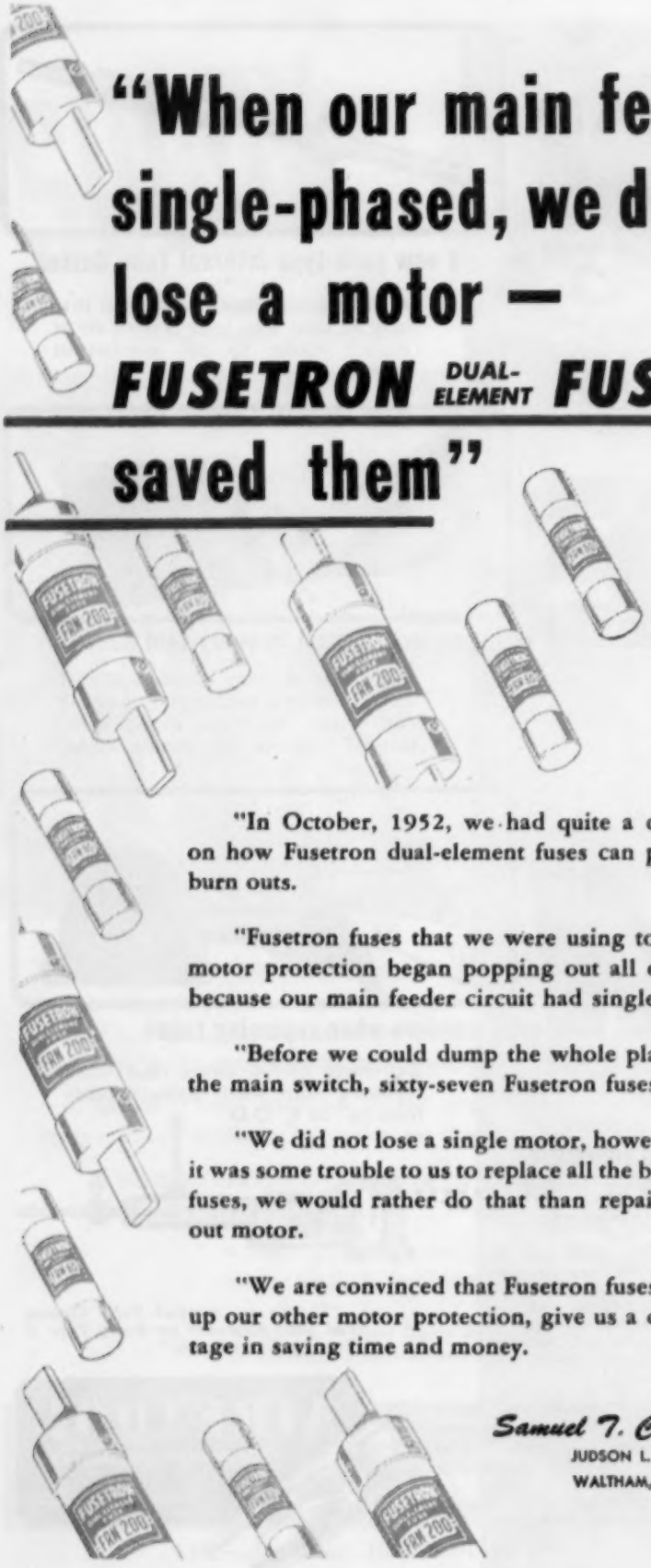
"When our main feeder single-phased, we did not lose a motor — FUSETRON DUAL-ELEMENT FUSES saved them"



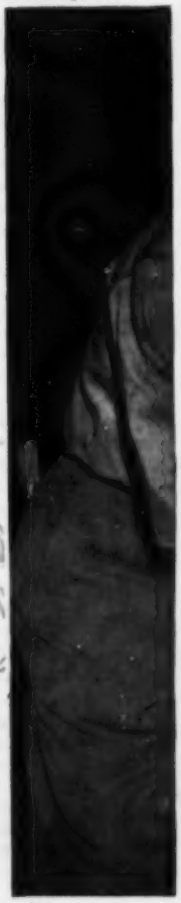
"In October, 1952, we had quite a demonstration on how Fusetron dual-element fuses can prevent motor burn outs.

"Fusetron fuses that we were using to back up our motor protection began popping out all over the plant because our main feeder circuit had single-phased.

"Before we could dump the whole plant by pulling the main switch, sixty-seven Fusetron fuses had opened.

"We did not lose a single motor, however, and while it was some trouble to us to replace all the blown Fusetron fuses, we would rather do that than repair one burned out motor.

"We are convinced that Fusetron fuses used to back up our other motor protection, give us a distinct advantage in saving time and money.



Samuel T. Craig CHIEF ELECTRICAL ENGINEER
JUDSON L. THOMSON MANUFACTURING CO.
WALTHAM, MASSACHUSETTS

FUSETRON dual-element FUSES DO MORE THAN PROTECT MOTORS AGAINST BURNOUT DUE TO SINGLE PHASING

. . . *They provide 10 Point Protection*

1. High interrupting capacity — protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.

2. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.

3. Protect against needless blows caused by harmless overloads.

4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5. Protect against waste of space and money — permit use of proper size switches and panels.

6. Protect motors against burnout from overloads.

7. Give DOUBLE burnout protection to large motors — without extra cost.

8. Protect motors against burnout due to single phasing.

9. Make protection of small motors simple and inexpensive.

10. Protect coils, transformers and solenoids against burnout.

AND FUSETRON FUSES REMAIN SAFE

without maintenance and recalibration costs

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

When a Fusetron fuse does open to protect, and after the fault has been corrected — the new Fusetron fuse you install has been calibrated at the factory by engineers — it is a fuse as safe and dependable as the one that blew.

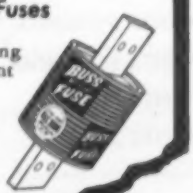
Blowing time charts and more information are available on Fusetron dual-element fuses. Write for bulletin FIS.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS . . . *Use BUSS Hi-Cap Fuses*

On 600 volts or less, they have interrupting capacity sufficient to handle any fault current regardless of system growth.

When coordinated with Fusetron fuses they will not open ahead of fuse nearest fault.

— Write for bulletin HCS —



Play Safe! *Install FUSETRON Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

1155

BUSSMANN Mfg. Co. *Division of McGraw Electric Co.*
University at Jefferson, ST. LOUIS 7, MO.

Circle 113 on READ-N-CIRCLE card for more data

new bulletins

. . . starts on page 18

427-Boiler instrument handbook
Boiler instruments to cover every phase of operation from water treatment to dust removal are contained in Bulletin GSP-901. Illustrations and text are combined to make this bulletin a necessity for engineers interested in boiler and steam problems. Twenty-six pages. HAGAN CORPORATION.

428-Electronic test equipment data
Illustrations and text contained in Bulletin R36A describe the complete line of test equipment available for servicing industrial electronic and electrical equipment. WESTON ELECTRICAL INSTRUMENT CORPORATION.

429-How to select asbestos packing
Specifications on how to select a proper asbestos sheet packing are contained in Bulletin 5050. Includes packing data for severe conditions, synthetic bonded types, neoprene and Hycar, and competitive qualities for selection of economical packing. Four pages. B. F. GOODRICH RUBBER COMPANY.

430-More for your lumber dollars
How to get more value for your lumber dollar is explained in this illustrated booklet. Classifications of softwood and hardwood lumber by trees, manufacture, use, size, and grade is thoroughly explained. A valuable booklet about man's most versatile material. Twenty-four pages. NATIONAL LUMBER MANUFACTURERS ASSOCIATION.

431-Read about control valves
Discussion of equipment for the control and regulation of steam, water, air, oil, and gas is contained in composite Bulletin C-50. This bulletin also contains descriptions of proper application for all pressure, flow, and liquid level controls. Four pages. MCALEAR MANUFACTURING COMPANY.

432-Lubrication for exposed gears
Physical specifications and test data for this lithium-base, adhesive petroleum oil are contained in Bulletin 105. Lubricant is recommended for construction machinery, elevator and escalator gear trains, mechanical presses, power shears, and winches. Two pages. THE ALPHA MOLYKOTE CORPORATION.

433-Pump stroke controls volume
Bulletin 955 describes operation of stroke length adjusting air system. Diagrams and illustrations include information on application, features, and specifications detailing its installation in a typical pneumatic flow-control system. Four pages. MILTON ROY COMPANY.

434-Open-blast gas burner nozzles
Bulletin H-15 discusses applications for open, or gap-type nozzles. Nozzles are recommended for installations where slight excess air in the combustion chamber around the burner is desirable. Dimensional installation data is also included. Four pages. ECLIPSE FUEL ENGINEERING CO.

435-Shock and vibration mountings
Vibration mountings for medium and heavy machinery are described in Catalog FP-55. The isolators are loaded primarily in shear for superior vibration isolation. Load capacities and frequencies, together with illustrations of typical installations, are described. Four pages. T. R. FINN & COMPANY, INC.

436-Package boiler tables
Bulletin PSG-2 contains tables of capacities, dimensions, and weights of nine typical package boilers. Includes illustrations of firing and control equipment plus recommendations for field installation for the three pressure-classes available. Ten pages. HENRY VOGT MACHINE CO.

437-Metal-cutting saw handy guide
Problem of selecting the right blade and cutting speed for your job is discussed in Catalog G-55. Describes metal-cutting band saws with capacities from 3½ inches to 16 inches, automatic bar feed equipment, stock stands, and accessories. Eight pages. WELLS MANUFACTURING CORP.

438-Remove fumes economically
Exhauster housings and impellers are available either in Haveg 41, or Haveg 60, as detailed in Bulletin 87. Chemical resistance tables are included showing

HENSZEY
CONTINUOUS BLOWDOWN
packet-type

complete, automatic control of boiler water concentration

Also Standardized or Special Units for ALL CAPACITIES.

PREVENTS PRIMING
PREVENTS FOAMING
PREVENTS SLUDGE
PREVENTS SCALE
(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

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Continuous Blowdown and Boiler Plant Specialties • Boiler Feed Regulators • Distillation Systems • Heat Exchangers • Feed Water Meters • Flow Indicators • Proportioning Valves
Also PROCESS EVAPORATORS, PREHEATERS, and SPRAY DRYERS

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Only Chapman Tilting Disc Check Valves give you

FAST TIGHT QUIET CLOSURE

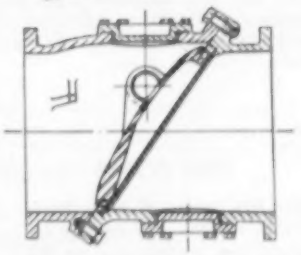
Fast, quiet operation means low cost operation for check valves. That's exactly what the Chapman Tilting Disc Check Valve is designed to do. It won't flutter or slam and damage the piping joints or the valve itself. The unique drop-tight closure action eliminates scraping and wear of the disc and seat.

Rugged construction and low wear of the Chapman Tilting Disc Check Valves mean long life under severe operating conditions. Absence of vibration plus low head loss keep maintenance of the entire piping system at a minimum.

Whether for replacement or for new piping systems, be sure to specify Chapman Tilting Disc Check Valves. They're available in iron and steel for handling fluids or gases under a wide range of pressures. For full data on the complete line, write today. Ask for Catalog 30-A.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

Here's why Chapman's Tilting Disc Check Valves Keep Quiet All of Their Lives



This specially designed "airfoil" disc balances perfectly in open position. The fluid holds the disc tightly against its stops without flutter. The body of the valve is larger around the disc, so the net valve area is at least as much as the pipe area to assure low flow resistance.

When the flow is reversed, pressure against the upper part of the disc cushions it as it closes. Then the disc drops easily and tightly to its beveled seat after the valve has swung closed. Seating is fast and quiet with minimum head loss in all but unusual piping arrangements.

Circle 146 on READ-N-CIRCLE card for more data

new bulletins

. . . starts on page 18

resistance of both materials to corrosive fumes. Capacity tables for both fan types are also included. CHAMPION BLOWER & FORGE CO.

439-Cement and concrete sealant

Uses of concrete sealant in improving curing process of newly-laid concrete, as well as in forming a smooth, durable coating on old concrete surfaces, is discussed in this leaflet. This sealant-preservative is available in three colors for interior or exterior use. SPECO, INC.

440-Materials handling automation

Answers to many questions about the place of overhead materials handling in automation are contained in Bulletin M-30. Contains illustrations and factual information helpful in adapting plant cranes to automation in your buildings. Twelve pages. WHITING CORPORATION.

441-Flexible coupling manual

Reference booklet describes Sphereflex line of curved root spherical tooth couplings. Includes data on installation, service factors, specifications, and lubrication. Features dimensional drawings of standard couplings, mill motor couplings, as well as horizontal floating shaft, standard spacer, vertical shaft, and vertical floating shaft couplings. Twelve pages. PHILADELPHIA GEAR WORKS.

442-Prevent boiler tube corrosion

Bulletin TR-537 discusses causes and methods of eliminating corrosion in boiler tubes. The data contained is the result of extensive studies by metallurgical experts. Eight pages. BABCOCK & WILCOX COMPANY.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

443-Simplify vibration elimination

Vibration mountings suitable for installations of heavy-impact machinery as well as delicate instruments are discussed in Catalog G-55. Diagrams and charts are included for easy selection of vibration mountings for specific needs. Eight pages. VIBRATION MOUNTINGS, INC.

444-Practical wire rope data

Slings, wire rope, and prefabricated wire rope assemblies are discussed in Ropeology Bulletin 5558. Performance of wire rope under extremes of low and high temperatures are also discussed. Four pages. MACWHYTE COMPANY.

445-New magnetic control

Float-operated control using magnetic fields of force to open and close electrical switches is explained in Bulletin L-119. Operates at pressures up to 250 psig. It controls boiler feed pump from the boiler water level, provides a low-water fuel cutoff, and closes electrical circuit for alarm signal. Four pages. MCDONNELL & MILLER, INC.

446-Ceramics conquer corrosion

Tables of physical properties and data on resistance to corrosion for five ceramic materials are included in Bulletin CHE-R5. This well-illustrated bulletin shows how ceramics are used in piping, fittings, valves, filters, pumps, heaters, or heat exchangers. Sixteen pages. GENERAL CERAMICS CORPORATION.

447-All-purpose water flow meters

Principles of operation of nutating-piston-type meters are explained in Bulletin 36. It contains illustrations and data of typical installations, trap strainers, air release valves, high-pressure meters, and meter registers for the measurement of most fluids. Twenty pages. BUFFALO METER CO.

448-Permanent magnet traps tramp iron

Applications and salient features of permanent magnetic drums are described in Bulletin MD-200. Three types of drum are available with gear, V-belt, or chain-and-sprocket drives. No electrical connection is required. Permanence of magnetic strength is guaranteed. Six pages. THE HOMER MANUFACTURING CO., INC.

449-General-purpose solenoid valve

Ten improved features of general purpose solenoid valve are described in Bulletin V 5004. Contains charts of sizes available and pressure operating ranges. Can be obtained in Class 1, Group D, and Class 2, Groups E, F, and G for hazardous locations. AUTOMATIC SWITCH CO.

450-Pneumatic regulator handbook

How to select pressure and vacuum regulators, ratio relays, and system purge assemblies is told in Bulletin H-2. Dimensioned sectional views, typical installations, and complete descriptive information are included. It also contains list of bulletins giving detailed information on other valves. Eight pages. CONOFLOW CORPORATION.

451-Pneumatic systems handbook

Complete discussion of all phases of pneumatic control is contained in Bulletin 1120. Separate sections are devoted to transmission of pneumatic signals, cascade and ratio control, time replay, interconnected control systems, and tuning controllers to your needs. Charts, sectional diagrams, and typical installations are also included. This well-illustrated informative bulletin is a necessary addition to the library of all engineers concerned with pneumatic control and transmission systems. Forty-six pages. MINNEAPOLIS-HONEYWELL REGULATOR CO., BROWN INSTRUMENT DIVISION.

452-Steam turbine for your job

New model turbines added to the existing line provide a total of eight horizontal steam turbine styles, permitting selection of the right turbine for the job. Single-sage construction and sleeve bearings make these turbines ideal for operation at medium steam pressures. DEAN HILL PUMP CO.

453-Flexible metal hose data

Installation data for flexible metal hose used in vibration absorption, diesel exhaust systems, and steam transmission are contained in this bulletin. Also included are bending radii, pressure and temperature ranges, and sections showing type of construction. Twelve pages. FLEXONICS CORPORATION.

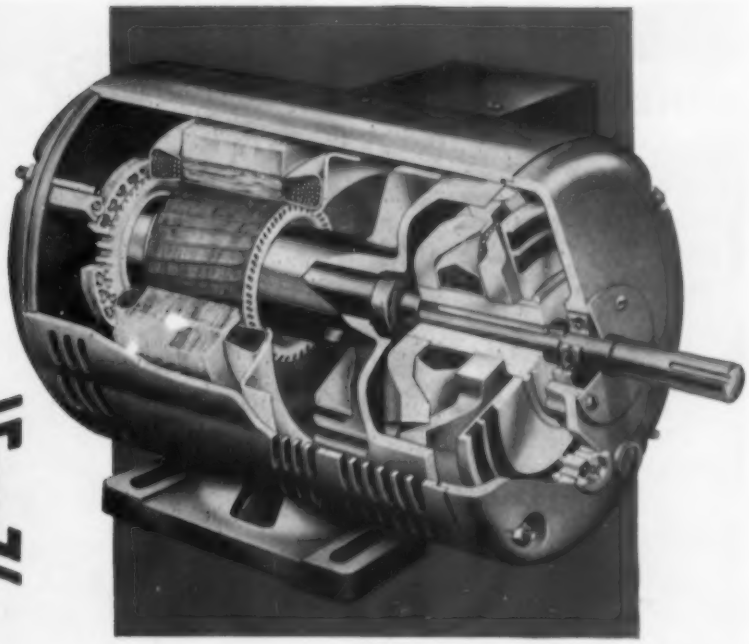
454-Centrifugal pump manual

Dimensional drawings, selection charts, and performance tables for the complete line of general purpose centrifugal pumps are included in Bulletin 7223-A. Suction and discharge positions, as well as V-belt, direct drive, and gear drive modifications, are also shown. Bulletin gives data on pumps with capacities of from 5 to 2800 gpm, and operating pressures of from 10 to 525 feet total head. Includes installation examples for the complete line of general purpose centrifugal pumps. Sixteen pages. INGERSOLL-RAND.

(more bulletins on page 74)

EATON

DYNAMATIC®



Stepless Adjustable Speed from an AC Power Source with Dynamatic Fractional HP Ajusto-Spede® Drives

These famous Ajusto-Spedes®—available in sizes ranging from ¼ HP to 75 HP—provide the solution to many drive problems at surprisingly low cost.

Fractional HP Ajusto-Spedes® are compact, self-contained units, an integral combination of AC constant speed induction motor, eddy current coupling, and electronic control.

All fractional horsepower Ajusto-Spedes® are rated 115/220 volts, single phase or 220/440 volts, 3 phase. Sizes are ¼, 1/3, and ½ horsepower at 1600 RPM; ½ and ¾ horsepower at 3200 RPM.

Write for your copy of the Dynamatic Ajusto-Spede® Bulletin FAS-4

Ajusto-Spede® Advantages:

- ★ Constant torque speed range: 25 to 1 with 1600 RPM and 3200 RPM Ajusto-Spedes®.
- ★ Control accuracy: 2 per cent of top speed at any point within the speed range.
- ★ Minimum wiring to power line.
- ★ Remote "one knob" control operation up to 100 feet.
- ★ Rugged plug-in type integral one-tube electronic control.
- ★ Permanently sealed grease-packed bearings.
- ★ Power output shaft extension at both ends of drive.

EATON MANUFACTURING COMPANY — DYNAMATIC DIVISION

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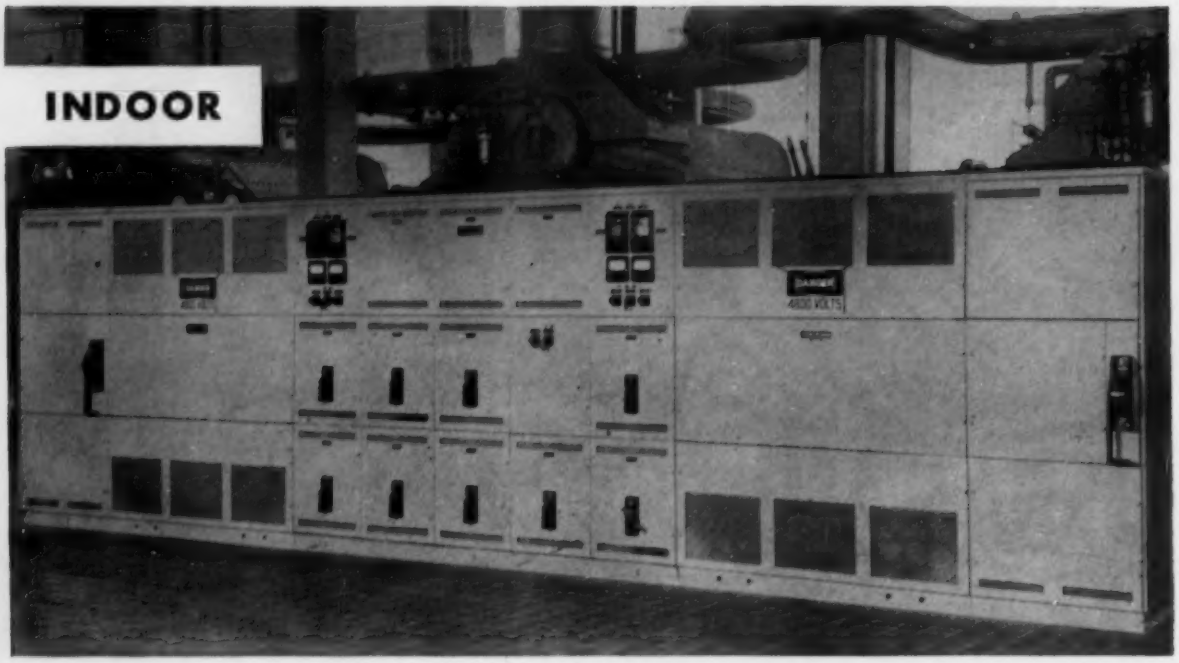
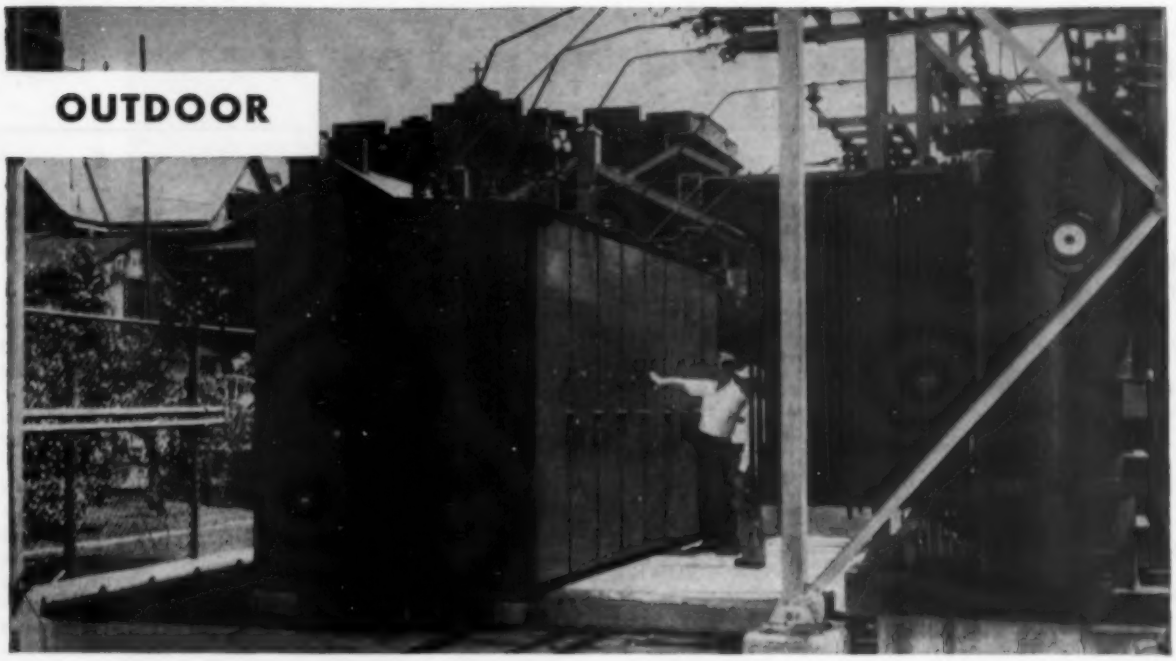


I-T-E, SINGLE SOURCE OF SUPPLY

Primary Section: Maximum protection on the primary side is assured with I-T-E Power Air Circuit Breakers. As an alternate to circuit breakers, roof bushings, throats, terminal chambers, oil cutouts, liquid disconnect switches or air interrupter switches may be furnished.

Transformer Section: I-T-E can supply any type of transformer required for a particular installation. It can be either liquid filled, nitrogen sealed, or dry type. All transformers match and line up with the primary and secondary sections to create one complete unit.



FOR COMPLETE UNIT SUBSTATIONS

Secondary Section: The secondary section consists of I-T-E switchgear. Completely interchangeable, horizontal drawout air circuit breakers are housed in a sturdy structure with completely isolated compartments, large rigidly braced bus, and a superior exterior finish.

You can buy a unit substation either of two ways: a piece at a time (the expensive way), or all at once (the economical way). I-T-E can sell you the individual elements, but recommends that substations be purchased complete, and from a single source of supply.

There are good, practical reasons for this. I-T-E's engineering assistance in over-all planning, floor layout, and choice of elements is more valuable to you when it covers the complete substation. Units are packaged and shipped ready to install without delay or complications.

There are further advantages in knowing that one dependable company stands behind your complete installation, and that all parts are designed to function as a unit.

I-T-E Primary and Secondary Unit Substations can be supplied for any application: indoor and outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Look in your classified directory under "Electric Equipment." I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pennsylvania.

I-T-E CIRCUIT BREAKER COMPANY
Switchgear Division

I-T-E

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our readers write

. . . to industry & power

Leaks a big problem

Gentlemen:

In your September issue, page 32, you described a plugging of leaks in a reservoir in Omaha, Nebraska.

We have a similar problem we are interested in, and wonder if you could send further information on this material as to the name of the manufacturer, etc.

R. E. Gilbertson
Marathon Corporation
Menasha, Wisconsin

Gentlemen:

In the September 1955 issue of INDUSTRY & POWER, you refer to a reservoir which was plugged with plastic.

We have a similar condition in a series of concrete coal silos which we would like to use for storing fuel oil.

Would you please give us the name, or names, of companies offering this plastic service.

Walter C. Schafer
General Superintendent
Wisconsin Ice & Coal Co.
Milwaukee, Wisconsin

Gentlemen:

An article on "Leaks in Reservoir Plugged with Plastic" appeared in your September 1955 issue on page 32. It would be appreciated if you could supply additional information pertinent to this project, such as trade names and sources of material used, and method of surface preparation of the areas treated.

It is to be understood that this letter represents an inquiry for engineering purposes only, and that it is not intended to constitute an order or commitment by or for the Ordnance Corps or the Government.

for the Commanding General:

A. W. Williams
Assistant
Ordnance Corps
Picatinny Arsenal
Dover, New Jersey

• *The Secoton coatings used on the reservoir walls are marketed by Surface Engineering Company, Inc., 1535 Barwise Avenue, Wichita, Kansas. The coatings are based on Bakelite vinyl resins, manufactured by Bakelite Company, a division of Union Carbide and Carbon Corporation, 260 Madison Avenue, New York 16, New York.*

Thank you just the same

Gentlemen:

I find INDUSTRY & POWER to be the best technical magazine in its class today and will be willing to pay for it should this be necessary.

John B. Harju
Consulting Engineer
Ferndale, Michigan

• *Thank you for the kind words. INDUSTRY & POWER is sent free of charge to all qualified engineers who express a desire to receive it.*

Refresher in homestretch

Gentlemen:

Have just read with interest "A Thermodynamics Refresher." For some reason I missed out on the first and second chapters. I would appreciate receiving a copy of the ones I missed.

During 45 years of working in steam-electric plants, I've read a lot of articles on thermodynamics but your "Refresher" tops them all.

G. G. Zimmerman
Efficiency Engineer
Spy Run Power Plant
Indiana & Michigan Electric Co.
Fort Wayne, Indiana

• *This request, and all of the many others we have been receiving for reprints of the "Thermo Refresher," is being filled promptly by our Reader Service Department. The concluding article in the Refresher Series appears in this issue. Early next year, we will begin a new Refresher Series, to cover electrical fundamentals. The author is eminently qualified. Watch for the Electrical Refresher coming soon in INDUSTRY & POWER.*

comment on nuclear power

Comment from the west

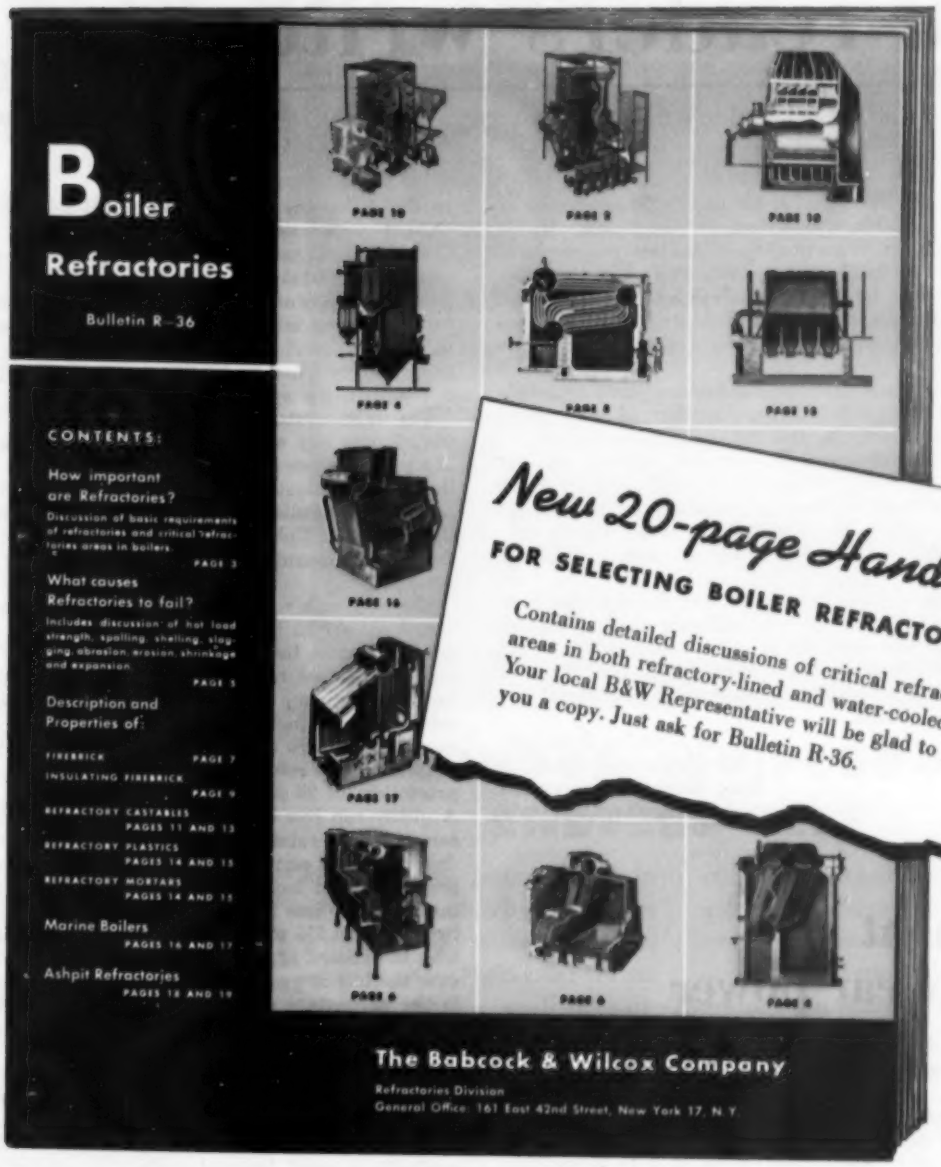
Gentlemen:

Byron Jackson has pioneered in pump equipment for nuclear reactors. They have either participated in the development and engineering, or have produced as a complete project, the pumping equipment for every nuclear reactor in use in the United States today.

At the present time, it is generally recognized that no one line of reactor development has provided the final answer for practical operating efficiency.

The Atomic Energy Commission is in the midst of a $200-million, five-year program to develop economical nuclear power plants, and is backing five different plans simultaneously. It is fair to expect that at the end of this period sufficient data will have been obtained to definitely establish a given reactor type as the most economical for a specific application. Electrical outputs will vary from 5000 kw to 60,000 kw.

Several of the major public utilities are now in the process of developing nuclear power plants, all utilizing different type reactor designs. At least one atomic power group is presently in the actual procurement stage. Electrical


Boiler
Refractories
Bulletin R-36
CONTENTS:
How important are Refractories?
Discussion of basic requirements of refractories and critical refractories areas in boilers. PAGE 3
What causes Refractories to fail?
Includes discussion of hot load strength, spalling, shelling, slagging, abrasion, erosion, shrinkage and expansion. PAGE 5
Description and Properties of:
FIREBRICK PAGE 7
INSULATING FIREBRICK PAGE 9
REFRACTORY CASTABLES PAGES 11 AND 13
REFRACTORY PLASTICS PAGES 14 AND 15
REFRACTORY MORTARS PAGES 14 AND 15
Marine Boilers PAGES 16 AND 17
Ashpit Refractories PAGES 18 AND 19
New 20-page Handbook
FOR SELECTING BOILER REFRACTORIES
Contains detailed discussions of critical refractories areas in both refractory-lined and water-cooled boilers. Your local B&W Representative will be glad to send you a copy. Just ask for Bulletin R-36.
The Babcock & Wilcox Company
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B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick
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Chemical Recovery Units • Seamless & Welded Tubes • Pulverizers • Fuel Burning Equipment
Pressure Vessels • Alloy Castings

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WORKS: AUGUSTA, GA.

R-630

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our readers write

. . . starts on page 30

output will vary from 100,000 kw to 190,000 kw, based on information available at this time.

Actual operation of some of these nuclear power plants is not scheduled until 1958 to 1960. The most attractive type of reactor to be used in nuclear power plants sized for industrial use will in all probability be determined from test data made available by reactors already in operation.

This premise leads us to think in terms of 1965 as a realistic date for the successful development of economical nuclear power plants for the industrial powerhouse.

The pumping requirements imposed by the various types of reactors and nuclear experimental units have been rather severe, varying in pressures up to 5000 psi and in temperatures up to 1600 F for radioactive water, liquid sodium, heavy water, bismuth, and radioactive slurry.

We will continue our intense nuclear development program to make available the most advance design pumping equipment for use with all types of reactors.

We sincerely hope that our efforts will contribute in part to the earliest possible development of industrial size nuclear power plants.

E. S. Dulin, President
Byron Jackson Division
Borg-Warner Corporation
Los Angeles, California

comment on nuclear power

Comment from the east

Gentlemen:

Karl P. Cohen's interview discussion of the potential development of the small reactor for industrial purposes, published in your September issue, is interesting, but incomplete.

It seems to me that there are too many features relating to the application of atomic power by small units that have been overlooked. To mention only three:

a. The quality of the personnel that will be required;

b. The time that will be required for maintenance;

c. The relative capital costs of nuclear plants as compared to more conventional plants — say diesels.

In addition, the interview contains a number of downright unsound or carelessly expressed observations. For example, the series of observations on page 44, relating to the difference between industrial and utility operations. I cannot understand these. Just what does Karl Cohen mean in saying, "So unless you are a utility (which can drown mistakes in estimates of operating costs in the financial depths of utility accounting), you find little room for cushioning mistakes in estimated operating costs. (A utility can absorb what has the effect of but a small estimating error when its 200,000-kw nuclear plant is part of a 4-million-kw system)"?

The utility systems of the country are more closely regulated than any other industry. Certainly every account of a utility is more closely regulated than that of the most tightly run industrial organization. Its accounting operations, I am certain, are far more closely prescribed than those of Karl Cohen's own company. In the light of all that, the comment on drowning mistakes is the sheerest nonsense.

The real nub with regard to possible applications of atomic power in industry is this: American industry in general cannot live very well, and does not live, on a much lesser net return than 10-15 percent on its capital and most industry operates almost entirely on equity capital. Under our income tax structure, for an industry to earn a net return of say 12½ percent on its capital it has to have a gross return, after local taxes, insurance and depreciation, of 26 percent (52 percent income tax basis). A utility can live on a 6 percent net return; but since it can generally raise at least 50 percent of its capital on a debt basis, its earning requirements on capital after depreciation and local taxes, again on 52 percent income tax basis, are less than 11 percent. The ratio between the two is almost 2½ to 1. This is one of the principal reasons why the record of industrial power in the United States over the last 30 years has been one of progressive decline in the percentage supplied by industry itself and a continuing increase of the percentage supplied by the electric utilities.

Nuclear power, when it comes into being, will accentuate that trend, since the burden of capital costs is much higher in nuclear power as against conventional. In my judgment, therefore, the amount of business that will be available in small isolated nuclear plants for industry is going to be even less than is available today in steam plants or in diesel plants. If this does not add up to something ultra-optimistic for those who are planning to enter the industrial atomic power market, it should still be of interest, and may be of help, to them if they are guided by this, to me, inescapable conclusion.

Philip Sporn, President
American Gas and Electric Service Corporation
New York, New York

Send for tear sheets instead

Gentlemen:

I tear out and file all wanted articles. . . . This is a convenient method.

Harry Arthur Brown
Assistant Mechanical Engineer
Bethlehem Steel Company

HOW TO BUY ENDLESS BELTS

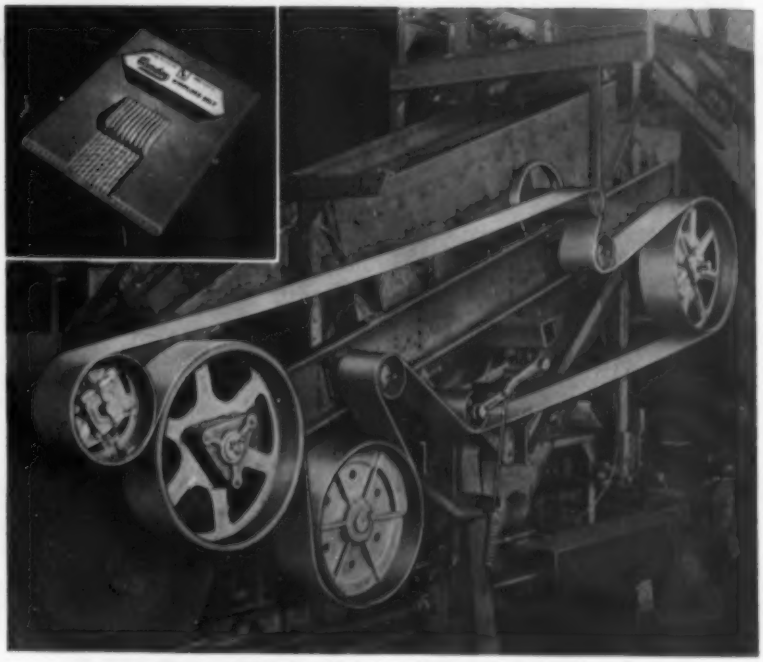
FOR LONGER LIFE on "Belt-Killer" Drives

"More Use per Dollar"

Look for a rubber belt engineered to give maximum flexibility and to eliminate belt shrinkage or stretch and separation at the cover-end.

Belt failures caused by excessive tensions, small pulleys and high speeds can be avoided by the careful selection of the endless belt you buy. Flexibility is of primary importance when selecting a belt for machines where serpentine drives supply power for several operations — for built-in drives with reverse bends and short centers. The belt you select should flex naturally in either direction . . . without stretching. It should be impervious to extreme atmospheric conditions because excessive shrinkage damages shaft bearings and shortens belt life. In ordinary belts, the cover-end tends to separate when rounding the pulleys because stress is concentrated in a narrow line seam. Look for the belt that extends the cover-end splice over a wide area so that stress is dissipated.

Specify, by name, the endless belt engineered to give you these advantages . . . specify Condor Whipcord Endless Belt.



CONDOR WHIPCORD ENDLESS BELT

An all-purpose belt designed for all types of endless drives, Condor Whipcord Belt offers exceptional advantages for "belt-killer" drives — short centers, small take-up, small pulleys, reverse bends, high speed and high tension. Extremely flexible, they feature an endless-wound, sealed-in cord construction which is pre-stretched during manufacture . . . they will not stretch or shrink on the drive and are virtually unaffected by variations in atmosphere. R/M's exclusive Extensible-Tip splice is a series of rubber rivets spaced over a wide area to secure the cover-end and eliminate cover separation. On some drives, Condor Whipcord Belts have outlasted 3 to 10 ordinary belts.

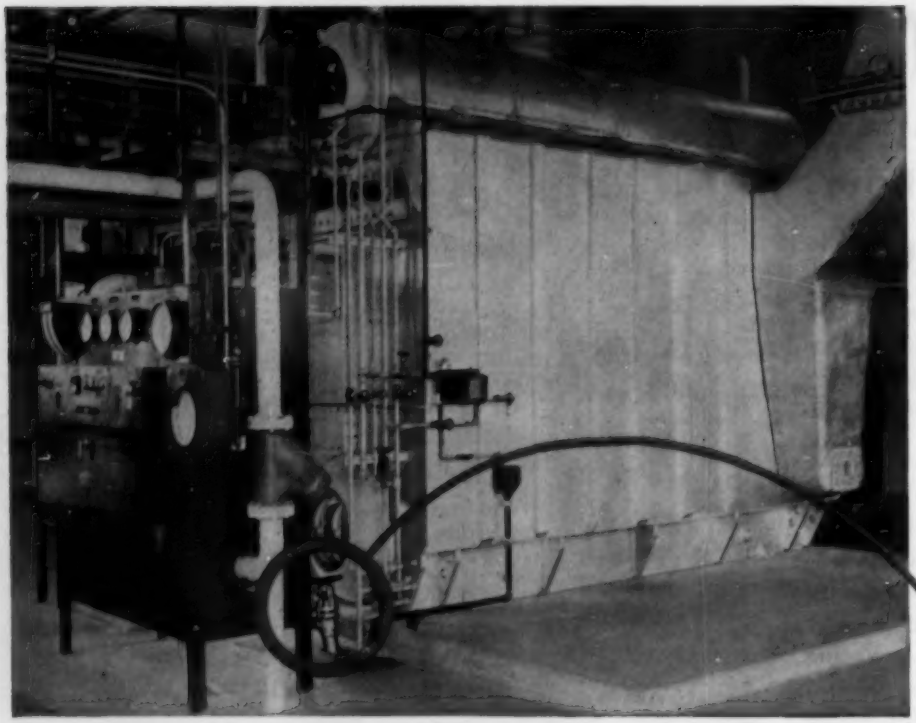
Let an R/M representative show you how you can get more dependable machine operation and longer endless belt life — "More Use per Dollar" — with Condor Whipcord Endless Belt.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

Circle 137 on READ-N-CIRCLE card for more data



COMBUSTION ENGINEERING ADOPTS YARWAY SEATLESS BLOW-OFF VALVES FOR PACKAGE BOILERS

Combustion Engineering, Inc. on this package boiler installation at the Orangeburg Pipe Plant in California, again includes Yarway Seatless Blow-Off Valves as part of the "package."

It's a popular idea—and growing fast. All *good* package-type boiler installations are *better* when equipped with Yarway Seatless Blow-Off Valves.

More and more boilermakers are standardizing on Yarways, and more and more boiler users are expecting the advantages of Yarway Blow-Off Valves on their package units.

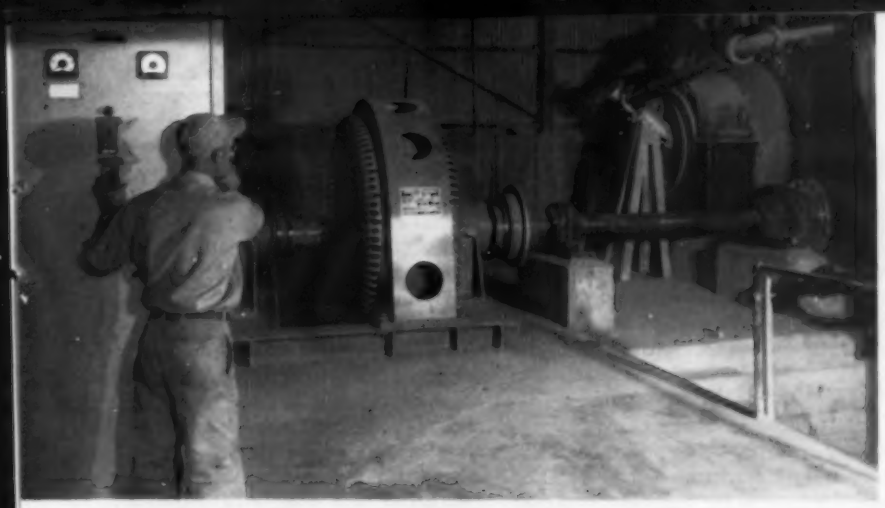
Get the full story on why more than 15,000 boiler plants use Yarway Blow-Off Valves, some for 30 to 40 years.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY BLOW-OFF VALVES

Circle 108 on READ-N-CIRCLE card for more data



Safety in starting is assured with remote control of this 500-hp motor.

I&P EXCLUSIVE

G. W. HEUMANN
Industry Control Department
General Electric Company

Proper CONTROL is important when you use CONSTANT-SPEED MOTORS

CONTROLLERS FOR constant-speed motors are available to suit all modern industrial applications. With a very wide choice of motor controllers available, the particular problems of the individual installation must be considered in selecting the controller.

Squirrel cage induction motors are the workhorses of industry. This is probably true because they experience speed variations of only a few percent between no-load and full-load. Their starting torque is 150 percent of rated torque, and allowable starting current is six times rated current. All these factors produce control problems.

Full-voltage starters

Full-voltage starting applies full line voltage to the motor immediately upon starting. The motor accelerates to full speed under its own speed-torque characteristic. Speed, starting torque, and starting current are not affected to any degree by the controller.

Full-voltage starting of dc motors is limited by the ability of the motor to commutate starting current. Only small motors, up to 1½ hp at 115 volts or 2 hp at 230 volts, have sufficient internal resistance to limit the starting current to a value that can be commutated.

Most squirrel cage, ac, motors are equipped with full-voltage starters. Squirrel cage motors can be started by connecting them directly to full line voltage, depending on limitations imposed by the driven machinery or the power system. Starters are rated in voltage and horsepower ratings, and are selected with regard to motor horsepower rating.

When low-cost control is desired, a manual starter may be used. They are commercially available in sizes 0 and 1. A starter consists of a triple-pole switching unit with three double-break bridge-type sets of silver contacts. The contacts are manually actuated through a toggle mechanism. Two thermal overload relays trip the starter open in case of overload. The same type of switch also can be obtained with a pushbutton mechanism.

A magnetic starter can be used if magnetic control is preferred. It consists of a triple-pole magnetic contactor with side-mounted thermal overload relays. The whole assembly is housed in a type 1 enclosure. The power elements (Fig. 1) are line contactor M and overload relays OL. Two alternative control circuits are indicated. In Fig. 1, line contactor M is actuated by a maintained-contact-type pilot device (perhaps a flow or pressure switch). This type of circuit is used when the motor is started and stopped automatically as with pumps or fans.

Fig. 1 also shows a circuit used for control by momentary contact pushbuttons. An auxiliary interlock on M seals around the START button, which may be released after the motor has been started. This connection provides undervoltage protection. If voltage fails, M drops out and stops the motor. When voltage returns, the motor will not restart unless the START button is pressed again. This protects the operator against injury from an unexpected start.

Extra auxiliary interlocks may be obtained for sequence interlocking, indicating lights, and signals. Several starters can be controlled from a common command station. The control circuit can be independent from the power circuit. Remote control from several sta-

tions can be accomplished by connecting additional start buttons in parallel and stop buttons in series. A control transformer may be added to step down control voltage to 110 volts for safer operation. Combination starters include circuit breakers or fused switches for short-circuit protection.

Full-voltage starting of squirrel cage motors has two disadvantages:

¶ First, it may be desirable to reduce the starting torque and avoid sudden strain on material (for instance in textile and paper processes).

¶ Second, power system limitations may restrict the maximum starting current causing excessive voltage drop. This is particularly true when motors are connected to combined power and light circuits. High starting current may cause light flicker. Starting current can be reduced by changing impedance of the motor primary circuit. This may be done by reconnecting the motor windings or by inserting external impedance to absorb a portion of line voltage. This procedure applies partial voltage to the motor.

Starting current is reduced in *direct* proportion to the ratio of applied voltage to rated voltage. Starting torque is reduced as the *square* of the ratio of applied voltage to rated voltage. Motor connections are changed to apply full voltage to the motor for normal running after accelerating.

Reversing starters

Polyphase ac motors are reversed by interchanging two lines to the motor. Two line contactors are required, one for forward rotation and one for reverse. Standard connections are shown in Fig. 2. Limit switches can be connected in the coil circuits to stop the drive automatically within definite limits at the ends of the forward and reverse travel.

Simultaneous closure of reversing contactors must be prevented to avoid short-circuiting of the line. Reversing contactors must be provided with mechanical interlocks, so that one contactor cannot close before the other contactor has dropped out. Electrical interlocking can also be included through back contacts of the pushbuttons or through normally closed interlocks on the contactors.

Initial voltage applied to the motor is reduced to a value below line voltage in a reduced-voltage starter. This reduces starting current and decreases the starting torque. Constant-speed dc shunt motors have resistance connected in series with the armature to reduce starting current to a value which can be commutated safely. The starting resistor is cut out in steps, with fully shunted current being applied at the instant of starting.

A discharge path for the shunt field is necessary to avoid damaging the field winding when the field circuit is disconnected. Standard controllers are available for nonreversing and reversing duty. A dynamic braking feature, in which the motor armature is short-circuited through a resistor to absorb energy from the load, can be included. Dynamic braking operates automatically when the motor is disconnected from the line.

Autotransformer starters

Connections for a magnetic autotransformer starter are shown in

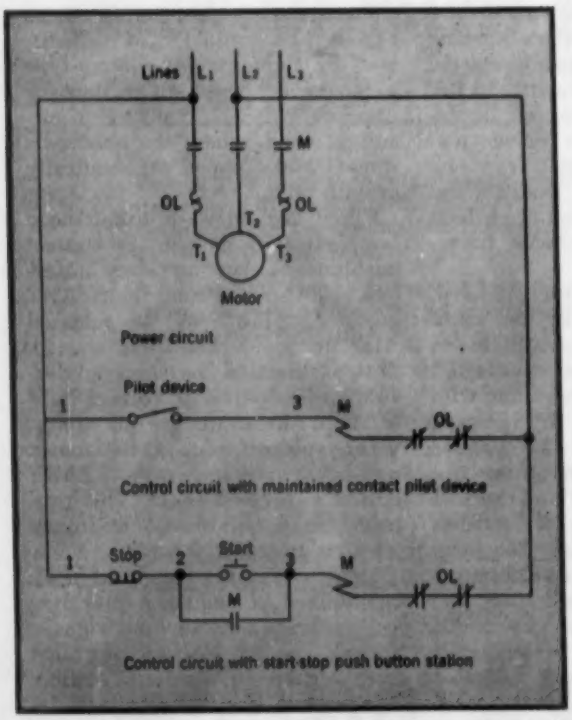


Fig. 1—Motor power circuit and two types of control circuits for a typical magnetic full-voltage starter.

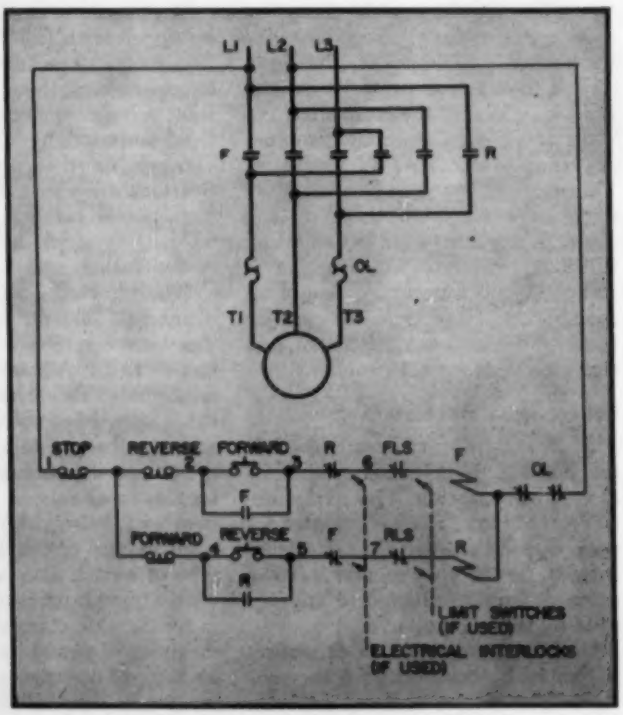
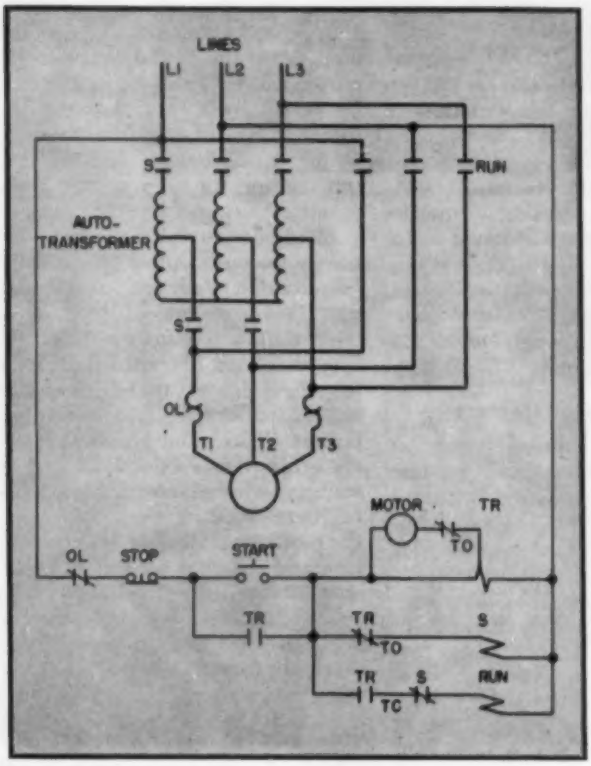


Fig. 2—Connection diagram of magnetic full-voltage ac reversing starter showing possible uses of auxiliary controls.



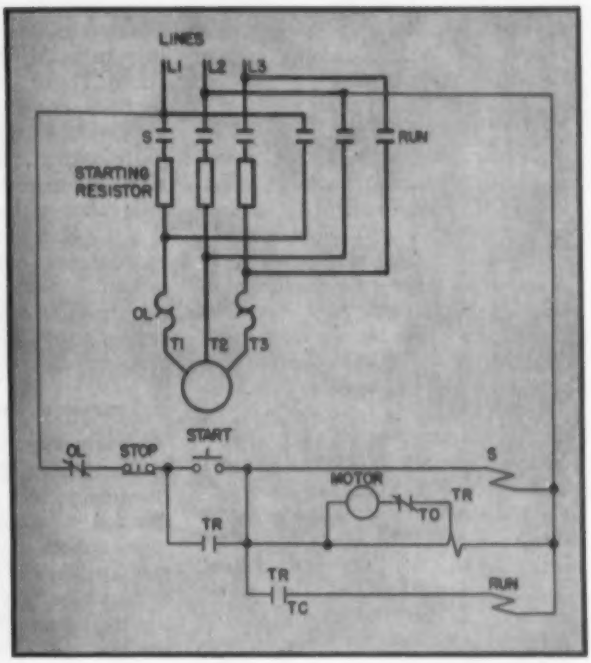


Fig. 3—(left) Magnetic autotransformer starter diagram.

Fig. 4—Magnetic primary resistance starter diagram.

Fig. 3. When the start button is pressed, contactor S closes, connecting the transformer to the line and the motor to a tap of the autotransformer. Contactor S drops out and run contactor RUN closes after a time delay governed by motor-driven timing relay TR. This connects the motor to full line voltage. Contactor S is a five-pole contactor to break the primary and secondary transformer connection during running. This prevents circulating current flowing in the transformer winding, and allows maximum use of transformers under short-time duty.

Autotransformer starters can be obtained for magnetic or manual operation. Transformers have taps for 50, 65, and 80 percent voltage, which give starting torques and currents of 25, 42, and 64 percent of the full-voltage values respectively. Autotransformer starters are the most expensive type of reduced-voltage starters. They do, however, offer the most effective reduction in starting current. They are preferred when the emphasis is on reduction of starting current because of power system limitations.

Another method of reducing starting voltage is to connect an impedance in series with the motor. A primary resistor is chosen for smaller motors because of low cost. For larger motors, a primary reactor is used to reduce losses and heating. Typical primary resistor starter connections are given in Fig. 4. When the start button is pressed, contactor S connects the motor to the line with the primary resistor in series. After a time delay set by timing relay TR, the run contactor RUN closes. This short circuits the resistor and connects the motor across the line.

Primary impedance starters

Primary impedance is chosen to limit the starting voltage across the motor and to obtain desired starting torque. As as example, an 80-percent reduction of voltage across the motor reduces starting torque to 64 percent and reduces starting current to 80 percent of normal. Primary impedance starters give a lesser reduction in starting current from the line, and are less costly than autotransformer starters. Primary impedance starters are preferred when the emphasis is on reducing starting torque rather than on reducing starting current.

Increment starters

Power companies may demand that starting current for large motors be raised to full value in limited ampere steps. This is particularly true when motors are connected to three-phase, four-wire combined lighting and power networks. In such cases, multistep, primary resistor, increment starters are chosen. Primary resistance is cut out in several steps with time de-

TABLE I
NUMBER OF ACCELERATING CONTACTORS FOR MAGNETIC WOUND ROTOR MOTOR STARTERS

Horsepower Rating	*Minimum Number of Accelerating Contactors*
15	1
75	2
150	3
300	4
600	5
1200	6

lay between steps. This allows the network regulators sufficient time to regulate the network voltage between starting steps.

Part-winding starters

Smaller size squirrel cage motors are built with reconnectable windings. This enables them to be connected to either a 220-volt or a 440-volt power supply. Each stator phase consists of two winding sections brought out to a terminal board. They are connected in parallel for 220-volt operation, and in series for 440-volt operation. A simple part-winding starter can be used when the motors are connected to a 220-volt or 440-volt system. These power circuits are shown in Fig. 5. There are two line contactors and two sets of overload relays. The start contactor closes first, connecting one half of the motor winding to the line. After a time delay, the run contactor closes, connecting the remaining half of the motor winding to the power supply. Initial starting current is reduced to approximately 70 percent of its normal value.

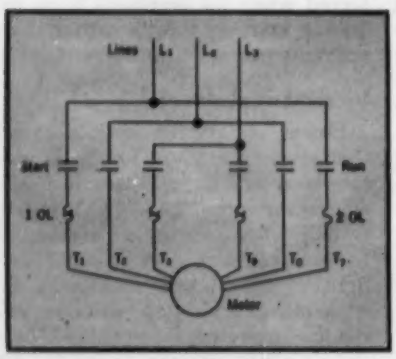


Fig. 5—Power circuits of a part-winding starter showing overload relays.

Delta-connected motors often have both ends of each phase winding brought out to a terminal board. These motors can be started by first connecting the windings in wye and then in delta. This reduces the motor starting voltage and the starting current in the ratio 1:1.73, and reduces the starting torque to one-third. Wye-delta starting is an inexpensive reduced-voltage starting method. It is popular in foreign countries but has the disadvantage of requiring separate motor connections.

Synchronous motor starters

Synchronous motors operate at a fixed speed determined by line frequency. As compared with induction motors they have advantages of higher efficiency and larger air gap. They also have better power factor, which may be made leading to improve the power factor of the plant. Modern synchronous motors are equipped with a squirrel cage starter winding on the rotor.

Synchronous motors are started like squirrel cage motors with full-voltage or reduced-voltage starting, depending on power system conditions. After the motor has accelerated to minimum slip as an induction motor, it is synchronized by automatically applying dc excitation. A synchronous motor starter incorporates a field application contactor and field relaying in addition to the full-voltage starting equipment.

The field application relays sense the slip frequency of the rotor winding. This determines when the motor has accelerated to its minimum slip as an induction motor. The relays then determine the angular position between the rotor and stator at which to apply field to obtain optimum synchronizing torque and pull the motor into step. After the motor has been synchronized its field excitation may be varied by a field rheostat. The motor then runs at unity power factor or may be excited to contribute leading kilovars to the power system.

Field excitation is removed when the motor pulls out of synchronism because of a heavy load or a voltage dip. This prevents torque pulsations that may damage the motor. The motor may be shut down or it may be allowed to resynchronize after a pullout, if load conditions permit. This choice is made by changing the connections on the starter terminal board. The squirrel cage winding overheats while the motor operates out of synchronism, and it is not protected by the conventional overload relays. A special squirrel cage protective relay must be used to provide full thermal protection to the synchronous motor.

Wound-rotor motor starters

Wound-rotor motors are generally used as adjustable-speed motors. They are sometimes used as constant-speed motors when it is desired to control starting current and starting torque in several steps. A wound-rotor motor starter contains a line contactor to connect the motor primary to the line. It is selected like a full-voltage starter. Resistance is connected to the motor slip rings. This resistance limits the motor starting torque to a desired value. The starting resistor is cut out in several steps by secondary accelerating contactors. The minimum number of contactors is given in Table I.

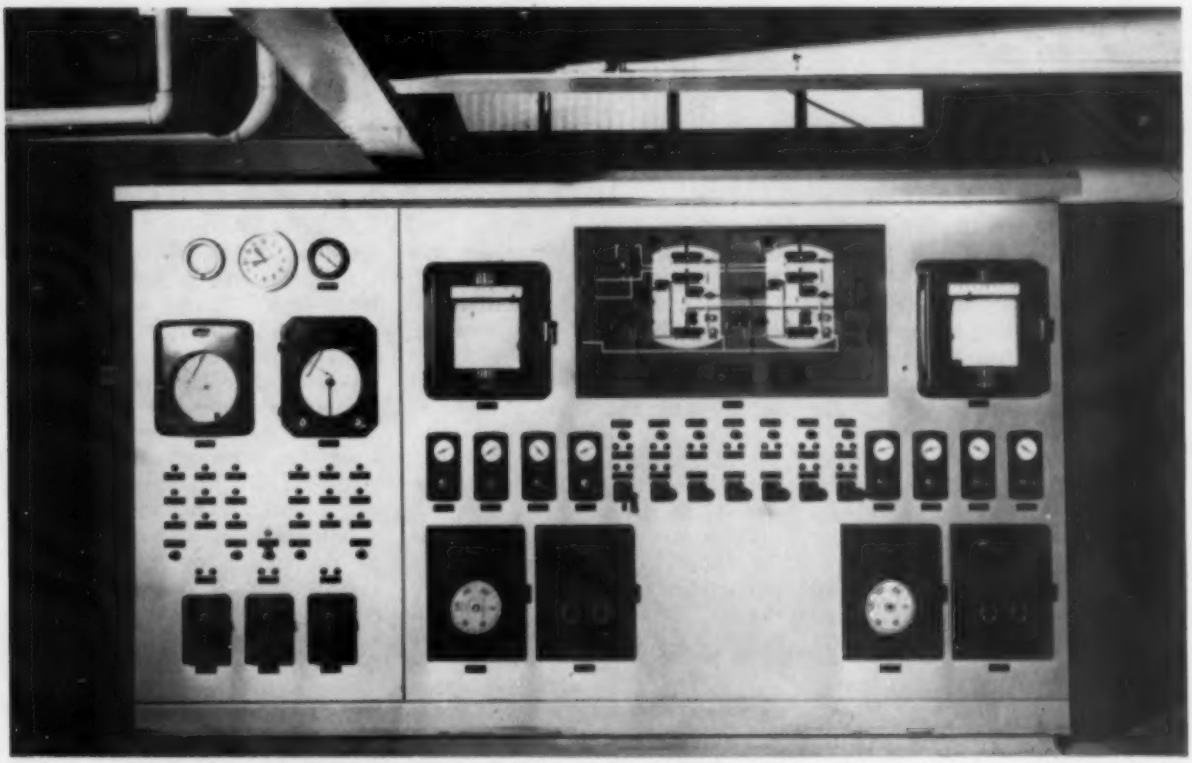
Starting resistors have been given NEMA class numbers, indicative of their starting duty, that specify their current capacity as a duty cycle. The class number also specifies the amount of resistance that determines the starting torque. Table II gives class numbers used to specify the resistor for wound rotor motor starters.

In the final selection of a motor controller, variables of cost, safety, and power system limitations must be reconciled before a decision is made. The importance of fitting the right controller to the job cannot be over emphasized.

NEMA CLASS NUMBERS FOR STARTING RESISTORS

TABLE II

Approximate Starting Torque in Percent	Light Start Duty Cycle 5 sec on 75 sec off	Normal Start Duty Cycle 10 sec on 75 sec off	Heavy Start Duty Cycle 15 sec on 75 sec off
25	111	131	141
50	112	132	142
70	113	133	143
100	114	134	144
150	115	135	145
200	115	136	146



Height of control panel was limited by headroom. Graphic panel has complete process flow diagram of two demineralizers.

AUTOMATIC control for mixed-bed DEMINERALIZER

I&P EXCLUSIVE

J. S. SAMKOFF
Instrumentation Engineer
Graver Water Conditioning Co.

AUTOMATIC MIXED-BED demineralizers at Pennsylvania Electric Company's Shawville generating station are producing an uninterrupted supply of boiler makeup water with around 3 megohm-cm resistivity and immeasurable traces of silica. The boilers were first filled 18 months ago. The plant has no standby evaporators.

Editor's Note: The author wishes to express his appreciation to Mr. V. F. Bolognese, Gilbert Associates, Inc. for reviewing this article.

The water supply (from the west branch of the Susquehanna River) is subject to wide variations because of coal mine drainage and the fast surface runoff characteristic of up stream mountainous regions. Raw-water pH varies from 3.1 to 5.0. Mineral and total acidities are sometimes as high as 55 and 125 ppm, respectively. Worst conditions occur during dry periods when total dissolved solids can be 650 to 750 ppm. Silica varies from 2 to 12 ppm, with an average of 5 ppm.

The river supply must be treated for whatever use is to be made of the water. Portable water and miscellaneous house services must be adjusted in pH, clarified, filtered, and reduced in hardness. Boiler makeup must be as pure as possible and free of silica.

At present, the station contains two turbo generators, each with a nameplate rating of 125 megawatts. Each turbine is served by one boiler rated at 894,000 pounds per hour at 1900 psig and 1055 F, with single-stage reheat at 402 psig to 1005 F. Engineering and supervision of construction were performed by Gilbert Associates, Inc. of Reading, Pa.

Raw water is pumped from the intake tunnel, prechlorinated, and sent to a Graver Reactivator. This is a solids-contact, upflow-type, has an orifice plate and a Foxboro d/p cell flow transmitter, which

sends a pneumatic signal to a recording and integrating flow receiver on the control panel. The integrator mechanism operates an electrical switch which closes every time 158 gallons are totalized. This, in turn, provides the impulse to start the chemical-feed timers. These timers run Graver Proportioner chemical feeders, which are basically gear-head synchronous motors that lower drawoff mechanisms for decanting chemical from the solution or slurry tanks. The high-rate treatment tank or clarifier. Three chemical feeders are provided for this unit. They are used for various combinations of ferric sulfate, caustic soda, hypochlorite, soda ash, lime, clay, and so on, depending on the results desired.

The clarified water goes to two gravity filters (each 10 feet in diameter and 12 feet high) and then to the filtered-water storage tank. From there it is pumped to potable-water storage, house service storage, makeup supply for the cooling system, and the supply to the demineralizers.

Demineralizer bed components

Each of the two mixed-bed demineralizers contains 100 cubic feet of Rohm and Haas 1R 120 cation exchange resin and 100 cubic feet of Rohm and Haas 1RA 400 anion exchange resin. Water from the demineralizers flow to the demineralized-water storage tank, which supplies makeup to the condenser hotwells. Hydrazine and morpholine are added to the boiler feedwater.

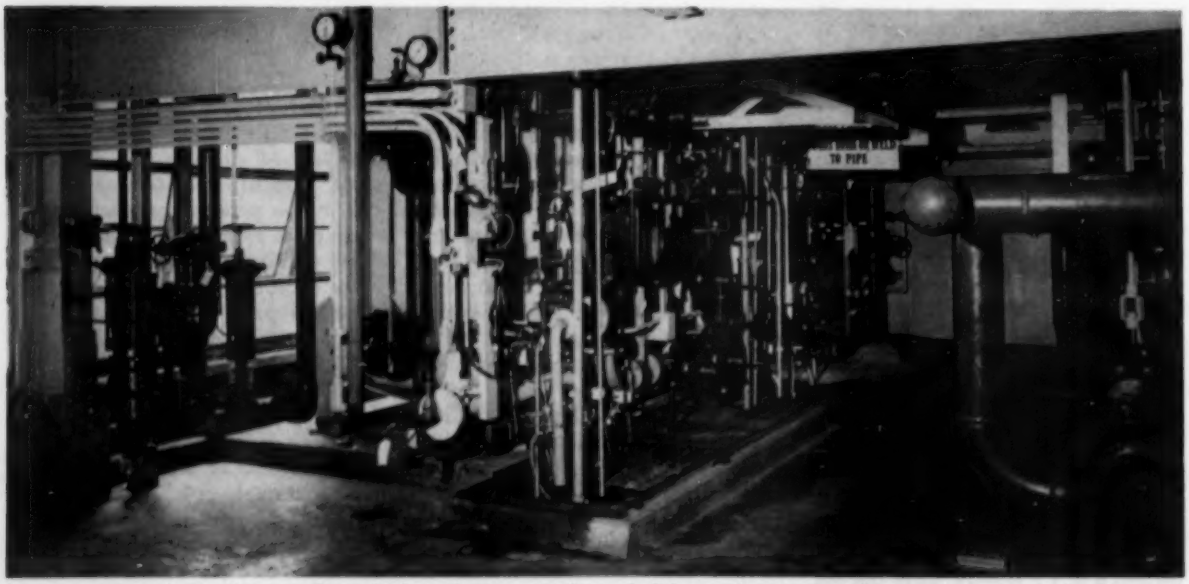
Since the clarifier and the filters are on the same level, the flow rate through the filters affects the level in the clarifier. A displacer-type pneumatic level controller with proportional action positions a diaphragm-motor inlet valve to maintain clarifier level. The inlet line chemical-feed tanks are mounted on the floor above the clarifier so that the chemical solutions or suspensions feed by gravity, but they are recessed into the floor to make recharging easier.

Filter rate of flow is controlled at the outlet by displacer-type level controllers in effluent-control sumps. The plant operator manually sets the control point in terms of level over a set of free-flowing orifices. This prevents excessive flow surges through the clarifier and filters. Filters are equipped with Builder-Providence loss-of-head diaphragm and pendulum units that are cable-connected to pedestal-mounted indicating gauges. Tape-operated float switches provide antidrain protection by operating solenoid pilot valves located between the level controller air output and the filter effluent diaphragm-motor valve. Backwashing and rinsing of the filters is strictly a manual operation, using gate valves controlled from floor stands located on a mezzanine near the filter tops.

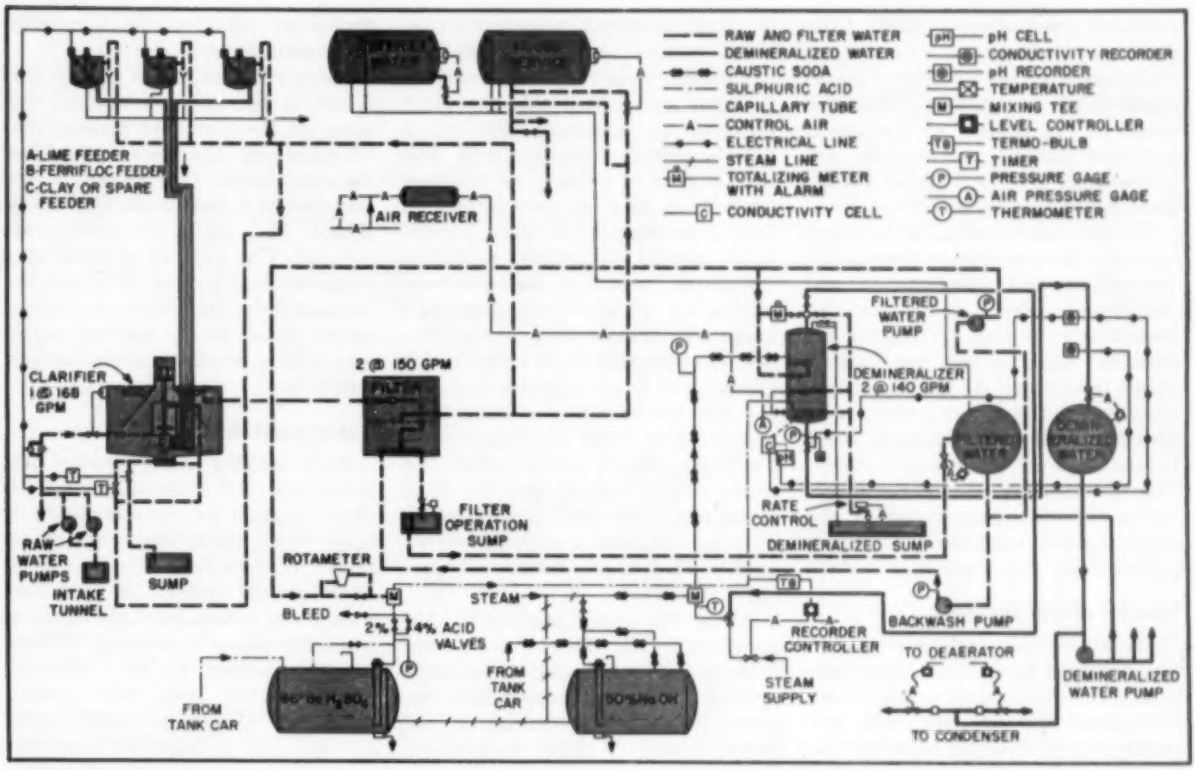
How level, flow are controlled

The filtered-water storage tank is provided with a Bailey mercury-manometer-type of level transmitter, which actuates an indicating gauge on the control panel. This level transmitter also controls an air-operated diaphragm valve in the filtered-water line to the storage tank to regulate flow rate. Tank level alarms are actuated by Mercoid float switches in external float cages. Substantially the same type of instrumentation is supplied for the demineralized-water tank.

Flow into the demineralizers is measured by positive-displacement meters that totalize the flow. They send an alarm and shutdown signal to the control panel when a unit has treated its calculated capacity. Regeneration waste outlet of each demineralizer is equipped with a Penn Linameter variable-area flow meter magnetically coupled to an indicating, pneumatic, rate-of-flow controller. Setpoint of the controller for backwashing, regenerating, displacing, and rinsing, is varied by air pressure signals that come from preset air loading stations mounted



Lower portion of one demineralizer, looking from control panel. Filter valve is at right, reactivator is in background.



Simplified flow diagram of water treating system. Filtered water supplies demineralizers, potable, and sanitary services.

on the control panel. A two-point conductivity recorder monitors the demineralized water coming out of each demineralizer, thereby providing checks on resin exhaustion, possible valve leakage, and sufficiency of rinse at the end of regeneration. Alarm contacts summon the plant operator and prevent bad water from going to storage.

pH readings erratic

A two-point pH recorder was supplied for the demineralized water, but the unbuffered characteristic of this high-purity water caused readings to be erratic. This recorder is now used chiefly to read the pH of the raw and filtered water. A portable conductivity bridge with a dip-type cell has proved very convenient for checking samples drawn from a number of points in different phases of plant startup and operation. This instrument is also useful in checking the concentration of acid and caustic solutions used in regeneration.

Although dilution-water flows are adjusted by rate-setting cocks under regulated pressure conditions and are measured by rate-of-flow indicators, conservative safety attitudes prevented rate-of-flow measurement on the strong regenerant lines. On-off control valves and rate-setting cocks are used. Although the practice of checking strong-regenerate flow rate with a conductivity measurement of dilute regenerate has worked well in this plant, the current trend is to use all-metal variable-area flow meters, often with rate-of-flow control on strong regenerant lines.

Most of the control valves have cast-iron, rubber-lined Saunders bodies with Conomotor, close-coupled, springless-diaphragm, on-off, air operators. The tops of the diaphragms are air-loaded to close the valves absolutely leak-tight. The air-loading system is provided with check valves and air capacity chambers to make all valves close on instrument air failure. The valves are opened from the control panel by applying air pressure to the lower half of the diaphragm motor to overcome the toploading. The valves that operate from the Linameter controllers are equipped with Moore positioners for throttling service. Strong-regenerant shut-off valves have single-seated bar stock bodies with spring-loaded diaphragm motors. They are made of stainless steel for caustic, or Hastelloy for acid service.

Control panel

The control panel for the water treatment system is located close to the process, in the water-treating bay. This area is conveniently reached from the main operating areas in the power plant.

The panel is a completely enclosed cubicle. Access doors are provided at each end, and internal lighting is installed. Personnel may walk inside for any necessary adjustments or maintenance work. The panel face is illuminated by a canopy that contains two 45-watt fluorescent Slimline lamps. The panel was furnished by Graver and fabricated by Metropolitan Electric Mfg. Co. It was shipped to the job site completely assembled, with instruments and control devices mounted in place. All electric wiring and pneumatic tubing intercon-

nections were already made. Connections leading to equipment mounted outside the control panel are brought to convenient terminal strips at the bottom of the panel. External tubing and wiring are underneath the floor of the water-treating bay in hanging troughs.

The left-hand portion of the panel contains the raw-water flow meter (recording and integrating) and the chemical-feed timers for the Reactivator. Running lights for the chemical tank mixers are located above the timers. At the top of this section are the filtered-water and demineralized-water storage level indicators and an electric clock. The temperature recorder-controller for the dilute caustic used in the demineralizer regeneration is also mounted on this section.

Special alarm system

An alarm annunciation system was designed by Gilbert Associates to signal operating conditions throughout the primary and secondary water-treating systems. Indicating lights are also mounted here. Inside the panel a dust-tight box contains banks of C.P. Clare Type-"J" plug-in relays for operation on a 125-volt dc power. Alarm indications are provided for such things as water quality, demineralizer capacity treated, chemical-tank low level, and storage-tank low level. Since all the instruments operate on 120 volts, 60 cps, an ac failure alarm is also supplied. In addition to the dc horn, an ac horn and silencing switch are provided for a dc failure alarm. Horn-silencing and lamp-test push buttons complete the system. Each alarm relay has an extra contact, all of which are wired to a terminal strip in the panel. Any of these contacts can be connected in parallel and used to actuate a water-treating alarm in the main control room.

The larger, right-hand section of the panel is devoted mainly to demineralizer controls. These include multiple-point conductivity and pH recorders with electrical contacts for operating alarm signals and shutting off demineralizers. This part of the panel also contains running lights for the electric motors associated with the water treating plant. Control selector switches are supplied for those pumps used in the demineralizer regeneration.

All motor starters are grouped in cubicle-type control centers. Selector switches enable the plant operator to manually shut off a demineralizer (usually only one unit is used at a time) or to direct its flow to rinse in case a purging flow is necessary following a shutdown period. Another selector switch is provided for properly setting up the electrical interlocks when the demineralizers are connected in parallel or in series (with either unit first). Pushbuttons are supplied for initiating an automatic regeneration cycle for returning a demineralizer to service after the alarm system signals that the final timed rinse is ended, and the plant operator is satisfied with the water quality. He can give additional rinsing if necessary.

Along the lower portion of this panel section are Bristol cycle controllers for automatic time-cycle control of each demineralizer regeneration. Each demineralizer requires a pair of these controllers. One of these instruments contains the timing mechanism to index the pilot-operating cam shafts of the pair. The controller with the time-disc drive removed has two small auxiliary timers for setting the duration of certain operations that are too brief to be notched on the time disc.

Last-minute changes necessary

Since this particular plant was designed at a time when the industrial application of mixed-bed demineralizers was very new, several last-minute changes were made in the regeneration cycle. Most of these changes were taken care of by adjustments to the cycle controllers. Two additional timers for each demineralizer were installed inside the control panel.

Since the operations of a regeneration cycle can be related to the opening of certain valves, the air pressure signals leading to these valves are used to select the proper flow rate for washing, rinsing, and so on. The air lines are connected to the diaphragm motor topworks of ¼ inch air pilot valves located inside the control panel. These small valves select which air pressure loading station (visible on the panel face) shall supply the control-point signal to the Linameter flow controllers.

Principal feature of the control panel is the graphic section that contains the complete process flow diagram of the two mixed-bed demineralizers. This section is constructed of a steel backing plate on which the tank silhouettes are painted. The plate is covered by a sheet of clear Lucite, to which are cemented Lucite strips of various colors. Black plastic symbols represent piping, control valves, pumps, and so on.

Valve position indicated

Each control valve symbol has green and red indicating lights to show whether its valve is closed or open. These lights are operated by SPDT Microswitches on the valves. Each pump symbol is provided with a red indicating light to show when the pump is running. (These are in addition to the "off-run" lights located near the control switches.) All pump running lights are operated by auxiliary contacts in their respective motor starters.

Piping symbols are color coded to designate chemicals handled, stages in the process, and so on. Valve symbols are made of black-on-white laminated plastic and have letter designations engraved into them. Legend plates just under the flow diagram explain the meanings of these color and letter designations.

The plant operator can tell at a glance exactly what is going on. Although operating flow rates are not shown by any miniature instruments in the flow diagram, the process equipment is so close that these factors can be readily observed. Manual operating functions are very easy to perform since the air pilot valves in the cycle controllers are labelled with the same letter designations that appear on the graphic-panel valve symbols.

Naturally, the graphic panel has been a great help in training operating personnel to become familiar with the fairly complex process of regenerating a mixed-bed demineralizer. Regeneration involves about 14 valves in 18 different operations totaling about four hours. Even though this is done automatically, it is essential that those who operate the plant understand the process.

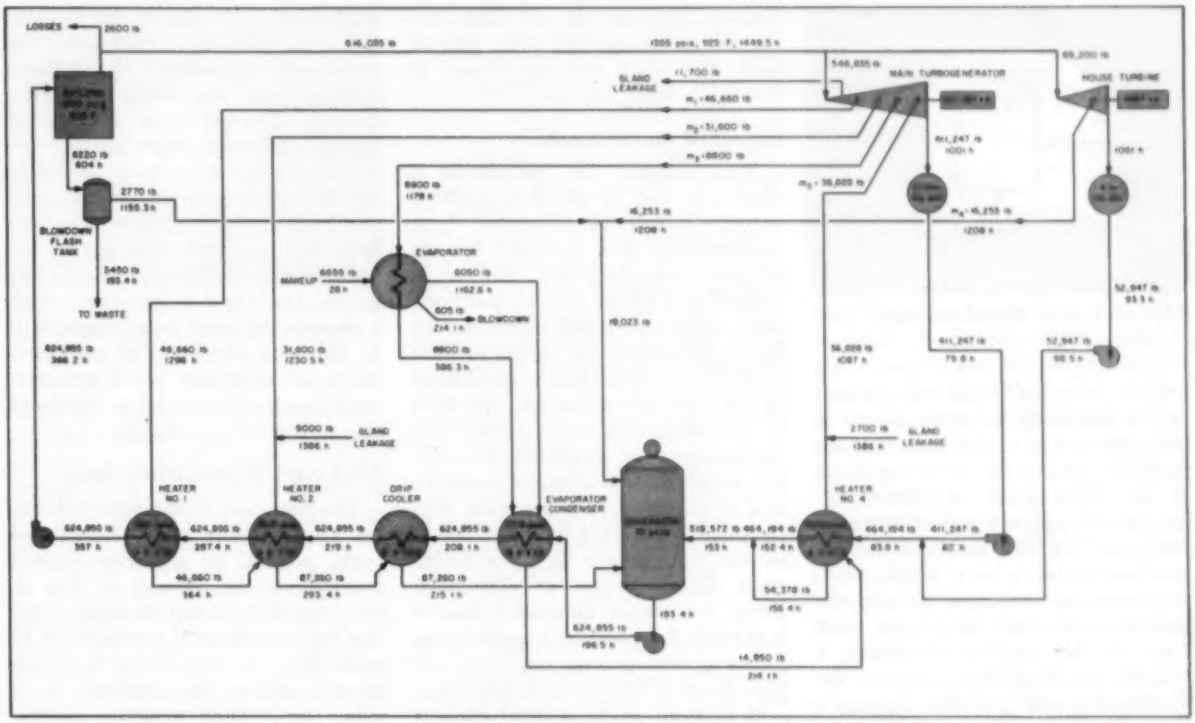


Fig. 1—Looking at flow diagram as a composite of several simple systems makes computation of heat balance easier.

A Thermodynamics Refresher — VII

How to COMPUTE steam powerplant HEAT BALANCES

JOHN F. LEE
Professor of Mechanical Engineering
North Carolina State College

Professor John Francis Lee received his BS at The Citadel Military College, North Carolina, and his MS at Harvard University. He worked as a mechanical engineer for Stone & Webster, in Boston, from 1940 to 1947, except for three years' war service with the U. S. Signal Corps in Europe. In 1948 he joined the faculty of the University of Maine, and moved to North Carolina State College in 1952. Professor Lee is currently engaged in research projects on the use of residual fuels in diesels for the U. S. Navy Bureau of Ships, and on the thermodynamic properties of nuclear reactor fluids for the Office of Naval Research. He has written two books — "Theory and Design of Steam and Gas Turbines" and "Thermodynamics."

COMPUTATION of a steam powerplant heat balance has always been looked upon by most engineers as an exasperating and confusing experience. Practically none of the textbooks present an adequate treatment of heat balance calculations, leaving the engineer to develop his own system of attack. Provided he is not discouraged by the complexity of the flow diagram, and that he is able to withstand the baptism of fire in computing his first heat balance, a system eventually will be evolved that permits a methodical solution of future heat balances.

Much of the difficulty associated with even the most complicated heat-balance computation evaporates when the flow diagram is viewed as a composite of relatively

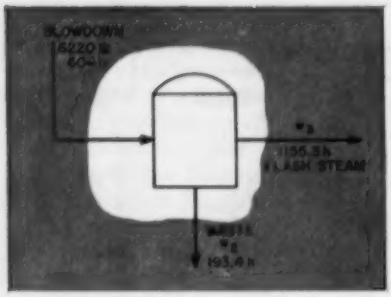


Fig. 2—Tackle blowdown tank first.

simple systems. Using the concept of the thermodynamic boundary to solve one piece of the heat balance problem at a time is a big help. If the First Law of Thermodynamics is applied relentlessly to each part of the problem and to the heat balance as a whole, then the solution becomes simple. To demonstrate the simplicity and logic of this method of attack, a slightly modified flow diagram for Pacific Gas and Electric Company's Kern Station at Bakersfield, California will be used as an example for our calculations here.

General approach

Heat balance computation for an existing plant is a relatively easy task, since nearly all data can be obtained by actual measurement. The problem of computing the heat balance for a proposed steam power plant is much more complex, however, because most of the data can be obtained only by calculation. In fact, a number of heat balances must be prepared for various load conditions and flow arrangements before a decision as to optimum design (from the standpoints of economy and performance) can be made. To illustrate, we shall compute a heat balance for one load and one arrangement only. The same procedure can then be used for any other load or arrangement.

The turbine manufacturer provides a condition curve for the turbine expansion that indicates the various extraction points available and the condition of the steam at these points. The manufacturer of the steam generator provides performance data including such items as efficiency, steam losses, and blowdown. Similar performance characteristics are supplied by the manufacturers of feedwater heaters, evaporators, and such auxiliaries as pumps and fans. Armed with this data we are ready to begin the heat balance.

Expected steam losses

Flow diagram for the station is shown in Fig. 1. Flow to turbine throttle has to be estimated from performance data provided by the turbine manufacturer. Flows of 546,835 and 69,200 pounds per hour seem to be reasonable estimates for the main turbine and house turbine respectively. The steam conditions at the turbine throttle are specified by the turbine manufacturer. The temperature of available circulating water fixes condenser pressure at 2.75 in. Hg abs for the main condenser. Considering pressure losses in the main steam line, the boiler must deliver steam at 1380 psig. From the steam generator manufacturer's data we can expect steam losses of 2600 pounds per hour and blowdown of 6220 pounds per hour.

A turbine offers several choices of extraction points. Also, any particular flow diagram for the station will permit several possibilities for the disposition of the gland leakage and the drips from the heaters. Therefore, a number of energy balances, such as the one we shall make here, must be made for various arrangements and various load conditions. Optimum heat balance, the one that gives the highest plant efficiency at all expected loads and is consistent with a reasonable plant investment, will be the one chosen. For our purposes an arbitrary plant arrangement has been selected to illustrate the method of calculation.

First part is blowdown tank

The first part of the heat balance we attack is the boiler blowdown tank, shown as an independent thermodynamic system in Fig. 2. We note that extraction steam from the house turbine is available at 19 psia (Fig. 1) and flows to a deaerator where the pressure is 19 psia (neglecting pressure drop). Therefore, the steam from the flash

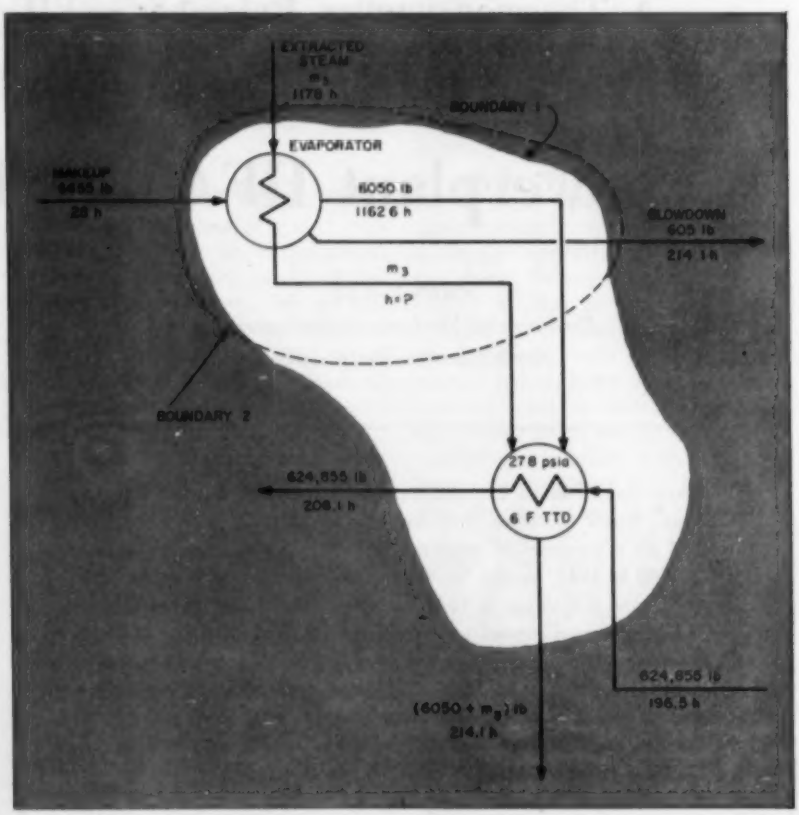


Fig. 3—Write equations for evaporator with condenser, then evaporator alone.

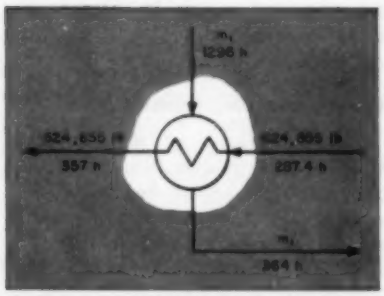


Fig. 4—Attack heater No. 1 alone since extraction steam enthalpy is known.

tank, which also goes to the deaerator, will be saturated steam at 19 psia (h = 1155.3). Blowdown will appear as saturated steam at boiler pressure plus the pressure exerted by the weight of water above the blowdown point. A total pressure of slightly less than 1450 psia is indicated, so that the enthalpy of the blowdown is about 604 Btu per pound. The waste from the flash tank will be saturated water at 19 psia (h = 193.4).

No heat flow here

Examining the boundary for the flash tank, we note that the tank is insulated so that there is no heat flow. Furthermore, no work is done across the boundary, so the energy equation, $Q - W = \Delta h$, reduces to $\Delta h = O$.

Adopting the convention that all quantities entering the system are positive and all quantities leaving the system are negative, we get

$$\Delta h = w_1h_1 - w_2h_2 - w_3h_3 = O$$

or

$$w_1h_1 = w_2h_2 + w_3h_3$$

and

$$(6220 \times 604) = 193.4w_2 + 1155.3w_3.$$

But $w_1 = w_2 + w_3$

or $w_2 = w_1 - w_3 = 6220 - w_3$

and we get

$$(6220 \times 604) = 193.4\,(6220 - w_3) + 115.3w_3$$

$w_3 = 2770$ pounds

$w_2 = 6220 - w_3 = 3450$ pounds.

These flows and enthalpies are now entered on the flow diagram.

Evaporator and condenser

Next system considered is the evaporator and evaporator condenser shown on the flow diagram of Fig. 1 and also in Fig. 3. The makeup entering the evaporator must replace steam losses from the boiler plus waste from the blowdown flash tank or 2600 pounds + 3450 pounds = 6050 pounds. In addition, the makeup must provide for blowdown from the evaporator, which is about 10 percent of the other losses or $(0.1 \times 6050) = 605$ pounds per hour. Total makeup is 2600 + 3450 + 605 = 6655 pounds at 60 F (h = 28).

Vapor from the evaporator leaves as saturated steam at the pressure of the evaporator condenser (27.8 psia and h = 1162.6). The drips from the evaporator also flow to the evaporator condenser. The condensate flowing into and out of the evaporator condenser is seen, from the flow diagram of Fig. 1, to be equal to the throttle flow of the two turbines plus the steam from the boiler blowdown flash tank and the vapor from the evaporator, or

546,835 + 69,200 + 2770 + 6050 = 624,855 pounds.

Make evaporator balance

Armed with this information and the fact that the drips from the evaporator condenser are saturated water at 27.8 psia (h = 214.1), we can make a heat balance for the evaporator and evaporator condenser together. Again we note that $\Delta h = O$. Let m_s be the quantity of extracted steam required and we get

$$\Delta h = 1178m_s + (6655 \times 28) + (624,855 \times 196.5) - (605 \times 214.1) - (6050 + m_s)\,214.1 - (624,855 \times 208.1) = O$$

$m_s = 8800$ pounds.

To find the enthalpy of the drips leaving the evaporator, we write an energy equation for the system enclosed by Boundary II as follows:

$$\Delta h = (8800 \times 1178) + (6655 \times 28) - (6050 \times 1162.6) - (605 \times 214.1) - 8800h = O$$

h = 386.3.

Heater No. 1

Next step is to make a heat balance for heater No. 1 (see Fig. 4). We know the enthalpy of the extraction steam (h = 1296) from data supplied by the turbine manufacturer. Enthalpy of the condensate entering the heater is the enthalpy of saturated water at the pressure of heater No. 2 less 6 Btu, since the terminal temperature difference of that heater is 6 F. As a result, we get h = 293.4 - 6 = 287.4. The enthalpy of condensate leaving heater No. 1 is, similarly, h = 364 - 7 = 357.

Again from an energy equation, now applied to the system of Fig. 4, we find

$$\Delta h = 1296m_1 + (624,855 \times 287.4) - (624,855 \times 357) - 364m_1 = O$$

$m_1 = 46,660$ pounds.

Heater No. 2 and drip cooler

Note that the drips from heater No. 1 are cascaded to heater No. 2. In addition to extraction steam, 9000 pounds of gland-seal leakage from the turbine also are introduced to heater No. 2. Since the enthalpy of the condensate entering heater No. 2 is not known, a heat balance for the heater and drip cooler (see Fig. 5) will be made. Enthalpy of the condensate entering the drip cooler is found

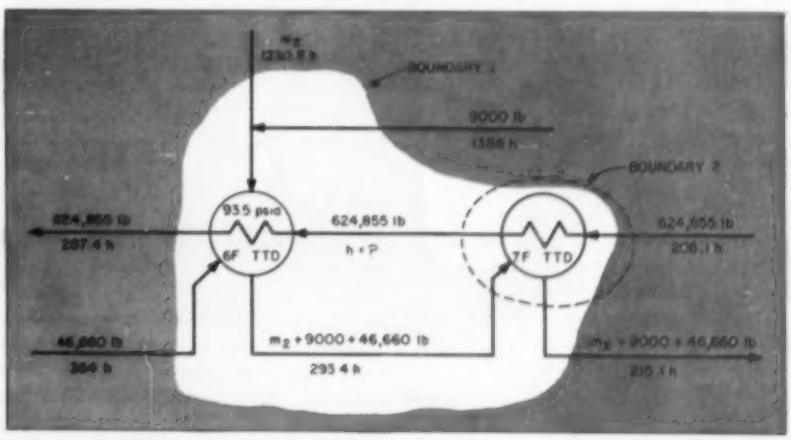


Fig. 5—Regard heater No. 2 and drip cooler as one system to find extraction steam enthalpy, cooler alone to find enthalpy of condensate entering heater.

from the data of the evaporator condenser, h = 214.1 – 6 = 208.1. Since the TTD for the drip cooler is 7F, the enthalpy of the drips leaving the drip cooler is h = 208.1+7 = 215.1. The enthalpy of the gland leakage, h = 1386, is known from the turbine data. The energy equation can now be written for this system as

$$\Delta h = 1230.5m_2 + (9000 \times 1386) + (624{,}855 \times 208.1) + (46{,}660 \times 364) - (624{,}855 \times 287.4) - (m_2 + 9000 + 46{,}660)\,215.1 = O$$

$m_2 = 31{,}600$ pounds

and the drips leaving the drip cooler are

$m_2 + 9000 + 46{,}660 = 87{,}260$ pounds.

To find the enthalpy of the condensate leaving the drip cooler (and entering heater No. 2), we make a heat balance for the drip cooler alone (boundary II shown in Fig. 5)

$$\Delta h = (624{,}855 \times 208.1) + (87{,}260 \times 293.4) - 624{,}855h - (87{,}260 \times 215.1) = O$$

$h = 219$.

Heater No. 4 and deaerator

We are now in a position to make the final assault on the heat balance. This step involves a heat balance for heater No. 4 and the deaerator. We cannot make a heat balance on either the deaerator or heater No. 4 alone, because two unknowns are involved, namely m_4 and m_5—the quantities of steam extracted from the house turbine and the last extraction point of the main turbine respectively.

Use two equations

We can base our attack on writing two simultaneous energy equations containing m_4 and m_5 as the unknowns. One equation is the heat balance for heater No. 4 and the deaerator included in boundary I of Fig. 6. The other equation is the heat balance for the deaerator alone (boundary II).

The respective energy equations are

$$\Delta h = (2770 \times 1155.3) + 1208m_4 + 1087m_5 + (2700 \times 1386) + (448{,}075 - m_5)\,82 + (14{,}850 \times 214.1) + (87{,}260 \times 215.1) - (624{,}855 \times 193.4) = O$$

or

$1.2m_4 + m_5 = 56{,}332$

and

$$\Delta h = (m_2 + 17{,}550)\,156.4 + (517{,}275 - m_5 - m_4)\,152.4 + 1208m_4 + (2770 \times 1155.3) + (87{,}260 \times 215.1) - (624{,}855 \times 193.4) = O$$

or

$264m_4 + m_5 = 4{,}266{,}495$ from which are obtained $m_4 = 16{,}253$ pounds and

$m_5 = 36{,}828$ pounds.

Only enthalpies remain

The enthalpies of the condensate entering heater No. 4 and the deaerator can now be found by writing energy equations for the simple systems shown in Figs. 6 and 7. For the condensate entering heater No. 4 we have

$$\Delta h = (411{,}247 \times 82) + (52{,}947 \times 98.5) - 464{,}194h = O$$

and the enthalpy is

$h = 83.9$.

Similarly, for the condensate entering the deaerator,

$$\Delta h = (464{,}194 \times 152.4) + (54{,}378 \times 156.4) - 518{,}572h = O$$

which yields the enthalpy

$h = 153$.

This completes all the required data for the heat balance. A final check should be made to be certain that arithmetical errors have not been introduced either in the calculations or on the various diagrams used along the way.

Finding the heat rate

Having completed the heat balance diagram and obtained the required data, we are in a position to

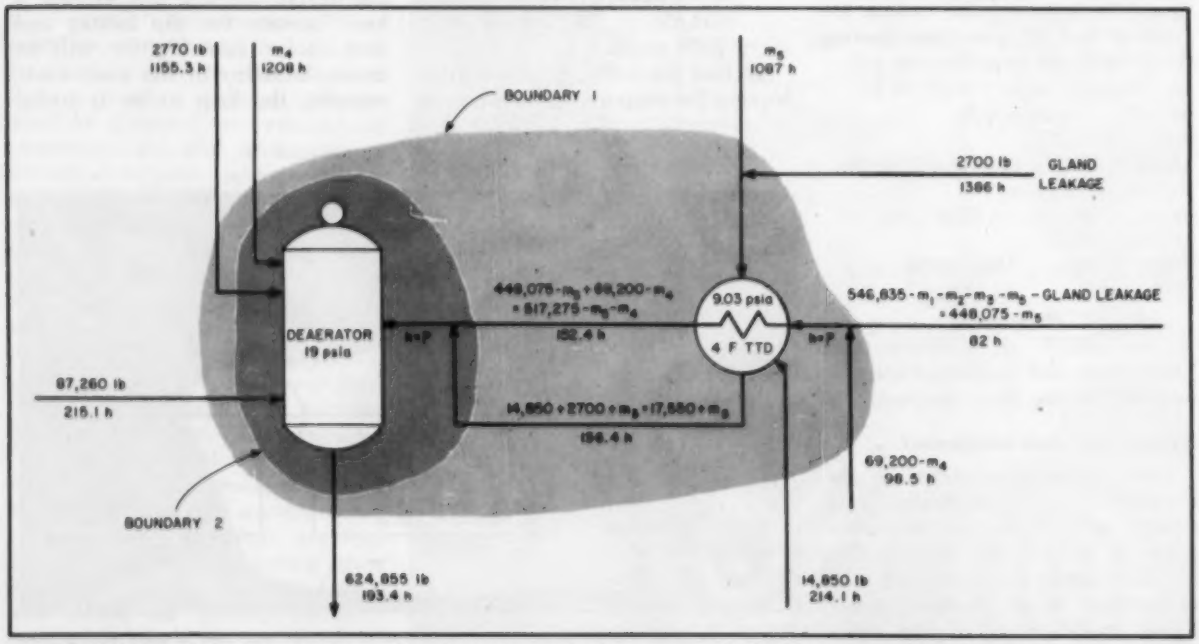


Fig. 6—Calculate deaerator and heater No. 4 together, and then separately, because two unknowns must be determined.

determine the relative merits of the arrangement from an economic standpoint. Size of heaters and pumps can be determined from the heat balance diagram. Comparisons with other arrangements can be made. One of the important

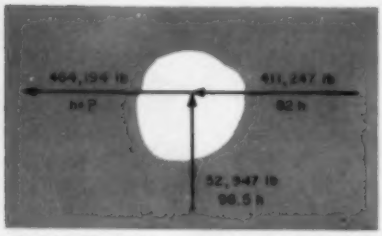


Fig. 7—Enthalpy entering heater No.4.

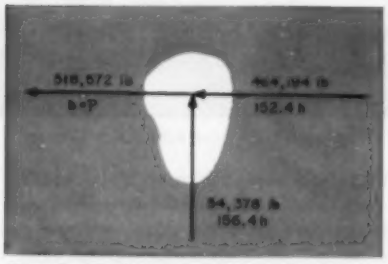


Fig. 8—Enthalpy entering deaerator.

end products of the heat balance is the heat rate. However, before computing the heat rate, it is necessary to calculate the work output of the turbines and the work input to the pumps to arrive at the net station output.

Because some of the steam is extracted from the turbine and lost as gland leakage, the entire throttle flow is not available to do work in the turbine. Work done in successive sections of the turbine is

546,835 (1449.5 – 1386)	=	34,724,023 Btu
(546,835 – 11,700) (1386 – 1296)	=	48,162,150 Btu
(546,835 – 11,700 – 46,660) (1296 – 1230.5)	=	31,995,213 Btu
(546,835 – 11,700 – 46,660 – 31,600) (1230.5 – 1178)	=	23,975,938 Btu
(546,835 – 11,700 – 46,660 – 31,600 – 8800) (1178 – 1087)	=	40,774,825 Btu
(546,835 – 11,700 – 46,660 – 31,600 – 8800 – 36,828) (1087 – 1001)	=	35,309,106 Btu
		214,999,391 Btu

Since there are 3413 Btu per hour in a kilowatt, the turbine output is

$$\frac{214,999,391}{3413} = 63,000 \text{ kw}$$

The electro-mechanical efficiency of the turbogenerator is 0.955. Generator output is $(63,000 \times 0.955) = 60,165$ kw.

The work done by the house turbine is

69,200 (1449.5 – 1208)	=	16,711,800 Btu
(69,200 – 16,253) (1208 – 1061)	=	7,783,209 Btu
		24,495,009 Btu

$$\text{or output} = \frac{24,495,009}{3413} = 7180 \text{ kw}$$

and the generator output is

$(7180 \times 0.955) = 6857$ kw

The work input to the pumps is 624,855 (196.5 – 193.4)	=	1,937,050 Btu
52,947 (98.5 – 93.3)	=	275,324 Btu
411,247 (82 – 79.8)	=	904,743 Btu
624,855 (366.2 – 357)	=	5,748,666 Btu
		8,865,783 Btu

or

$$\frac{8,865,783}{3413 \times 0.98} = 2650 \text{ kw}$$

The boiler efficiency, taking into account steam and water losses, is 0.859. Total steam generated is 624,855 – 6220 = 618,635 pounds per hour. The energy supplied by the fuel is, therefore,

$$\frac{618,635\,(1449.5 - 366.2)}{0.859} = 780,600,000 \text{ Btu}$$

Finally, by definition, the heat rate is the ratio of the energy supplied by the fuel (in Btu) to the net station output in kilowatt-hours, or

$$\text{Heat rate} = \frac{780,600,000}{60,165 + 6857 - 2650} = 12,150 \text{ Btu per kwh.}$$

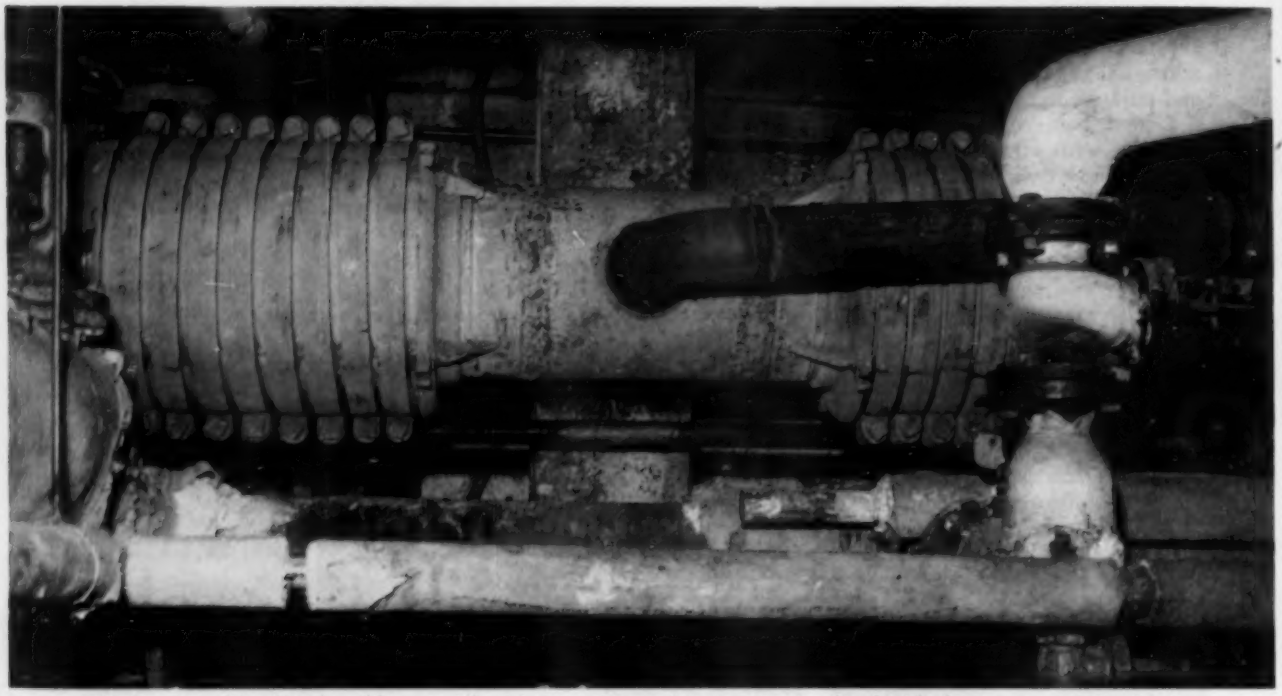
Some reflections on automation

AUTOMATION IN the ultimate implies that a sequence beginning with an input (say, raw material) and proceeding to an output (say, a finished product) of predetermined properties and characteristics will be accomplished without human labor or direction, other than to design the equipment and the process, initiate and stop the sequence, and to repair and maintain the equipment. . . .

The "higher level decisions" will be made by man primarily because he, through the exercise of his mind, possesses the only means of integrating and interrelating data for which rational formulation would be too expensive. . . . There will probably always exist situations. . . . [which] will favor the use of manual labor. The use of the human body for the creation of work (energy rate) is natural and proper, subject always to the limitations imposed by the physiological and psychological requirements inherent in the characteristics of the individual and of his environment. . . .

Automation will tend to reduce the rate of consumption of our natural resources if only because automation usually forces a change in the direction of decreasing entropy increase in the system and/or process. But, in addition, the increased awareness of the problem of the finite extent of our resources and the almost unlimited absorptive capacity of the products derived from these resources by the world population will be a result of the analyses which underlie design for automation. Needless to say, the present rate of consumption of the natural resources of the world deserves the utmost attention.

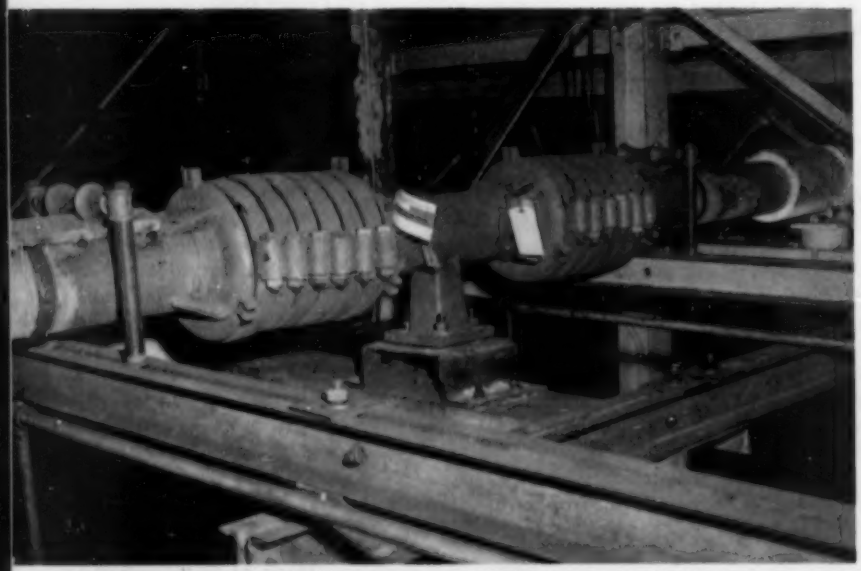
—L.M.K. Boelter
Dean of Engineering
University of California.



Inaccessible locations like this played havoc with maintenance costs for steam mains fitted with slip-type expansion joints.

How Chrysler licked a MAINTENANCE headache

I&P EXCLUSIVE



For long pipe runs, double-type expansion joints are used. Central mounting bracket is bolted to solid support and steam pipe rides freely on roller supports.

W. R. TIMM
Supervisor, Pipe Department
Chrysler Corporation

PIPING ENGINEERS have always been faced with the problem of allowing for the expansion and contraction of pipelines due to temperature changes. For Chrysler engineers at Highland Park plant, this was a particularly serious problem since the steam mains to the plant had to be shutdown for three days every year to allow for repacking of the glands on the expansion joints. Slip-type expansion joints needed periodic maintenance in the form of lubrication with an insoluble graphite grease. As the joint became older and more worn, it had to be repacked more fre-

quently. Leaking steam and water added a safety hazard.

It took two men a full working day to repack two 12-inch joints. The only time that the mains could be shutdown was during holiday weekends, so overtime rates had to be paid. Most joints were located in inaccessible positions — either supported from the building trusses, or inside the power services tunnel leading from the boiler room to the plant.

The tunnel is about seven feet wide by eight feet high, and is one-half mile long. It carries gas, water, electricity, and steam mains between the boiler house and the plant. The steam main is a 12-inch pipe. Condensate returns through 6-inch pipe. Steam is used for heating the plant, stock washing, and for heating bonderizing and plating tank coils. First packless expansion joints to be installed were not internally guided. After a short time they buckled. A four-inch channel iron frame was built around the joints for the flanges to run on. This cured the problem.

Close-up shows one of the guide saddles (shoes) that are welded to pipe. These bear on rollers, which take some of the weight and help to keep pipe aligned.

When packless joints were first used, they were not internally guided. This channel-iron frame, which was built for pipe to run on, has stopped buckling.

Already, six 10-inch, five 12-inch, three 8-inch, and four 6-inch joints have been replaced. The program should be completed upon changing three more this year.

Mains must be properly aligned before installing the expansion joints. Chrysler has found that it is best to remove the old joint plus two or three feet of pipe on one side of the joint. The replacement joint is then positioned and bolted down to some rigid support. The end of the joint nearest to the pipe is welded to the pipe with a portable electric welder. This leaves a two- or three-foot opening between the other end of the joint and the pipe. A distance-piece of pipe is cut to exactly fit this space. It is then welded at the ends to pipe and joint. This distance piece corrects any slight misalignment in the pipe.

Use another type now

More recently, Chrysler has been using internally guided expansion joints, which eliminate the need for the channel iron guide frame. A guide shoe is welded to the pipe at the free end of the expansion joint to act as a bearing surface for a roller guide, which helps to keep the pipe aligned.

The pipe is insulated with 85 percent magnesia right up to the expansion joint, but the joint itself is left uncovered.

Since the packless expansion joints were installed, they have required no maintenance whatsoever. Chrysler engineers are sure they will have no more shutdowns for expansion joint maintenance.

Adequate fire protection is worth considering. These two rows of water-fog nozzles cover transformer from all angles.

So you're going to Buy a TRANSFORMER!

I&P EXCLUSIVE

E. H. COXE
Supervisor, Rectifier Substations
Ethyl Corporation

E. H. Coxe graduated in electrical engineering from Lehigh University in 1923, and has studied at Carnegie Tech. and Louisiana State University. His experience includes electric station design, construction, and maintenance work for the Duquesne Light Company, the Aluminum Company of America, and the Ethyl Corporation. He has also done motor-control application work for Westinghouse, and cable-application work for General Cable Corporation.

GOING TO BUY a transformer?

You have many decisions to make if you are going to spend your company's money advantageously.

Assume that you have to carry a three-phase distribution load and that the required load has been established at 5000 kva. You now must decide how much capacity above this immediate requirement is to be purchased to allow for future load growth. Here are some more of the questions which you must answer:

Primary voltage probably will be fixed by your power source, but the number and spacing of taps above and below nominal will have to be determined. This will depend on probable variations in primary voltage and the required or permissible variations in secondary voltage. If the load cannot be dropped or transferred, you may have to provide for tap changing under load. If the low-voltage distribution system is not already built, you may have to decide the most economical secondary distribution voltage before drawing up your transformer requirements.

Present trends are toward use of

three-phase transformers because of economy in dollars and space. If the transformer in question is to operate in parallel with others to which the load can be shifted in case of outage, a three-phase transformer would probably be your choice.

Why consider single phase?

Single-phase transformers, however, have some advantages that entitle them to consideration. For a given bank capacity, there will be less weight to handle in one piece. They can operate open delta (assuming a delta/delta connection) at 58 percent of bank rating. A spare can be kept on hand at just 33 percent more than total first cost and switched into the circuit in place of any individual transformer which might fail. However, this last statement bears close investigation, for the difference in cost between two three-phase transformers, giving 100-percent spare capacity, and four single-phase transformers may be small. Don't forget that transformers that are to operate in parallel must have the same percent impedance and voltage ratios, or they will not share the load in proportion to their capacities.

It is probable that such a large transformer (5000 kva) would be installed out-of-doors. Should indoor installation be necessary, however, you would want to consider nonflammables instead of oil for cooling and insulation to eliminate fire hazards of oil. You can't change your mind about this at the last minute. Insulation designed for immersion in oil will not stand immersion in the nonflammable fluids.

A dry-type air-cooled transformer of this size might be of questionable practicability, and voltage requirements probably would rule it out anyway.

Method of cooling?

You will have a choice of self-cooling, water-cooling, fan-cooling, forced-oil-air-cooling, and forced-oil-water-cooling. A self-cooled transformer will have external radiators through which the oil will circulate by thermosyphon action. A water-cooled transformer will have water coils in the transformer for heat removal. A forced-oil-cooled transformer will have a circulating pump to circulate the oil through an external air or water heat exchanger.

The rating of a self-cooled transformer can be increased by the use of fans to circulate more air across the radiators. Impedance, in percent, will increase in proportion to any increase in rating which you may give your transformer (such as by using fans) after it is built and rated.

Unless space limitations or ambient air temperature make self-cooling undesirable, that method would probably be your choice. Pumps, fans, and a water supply can be a nuisance and can increase your maintenance costs. If you buy transformers with radiators, be sure that they have no unreachable cracks or corners that cannot be cleaned for proper painting. This is of particular importance if you are operating a chemical plant. A water-cooled transformer may offer lower first cost than one built for self-cooling.

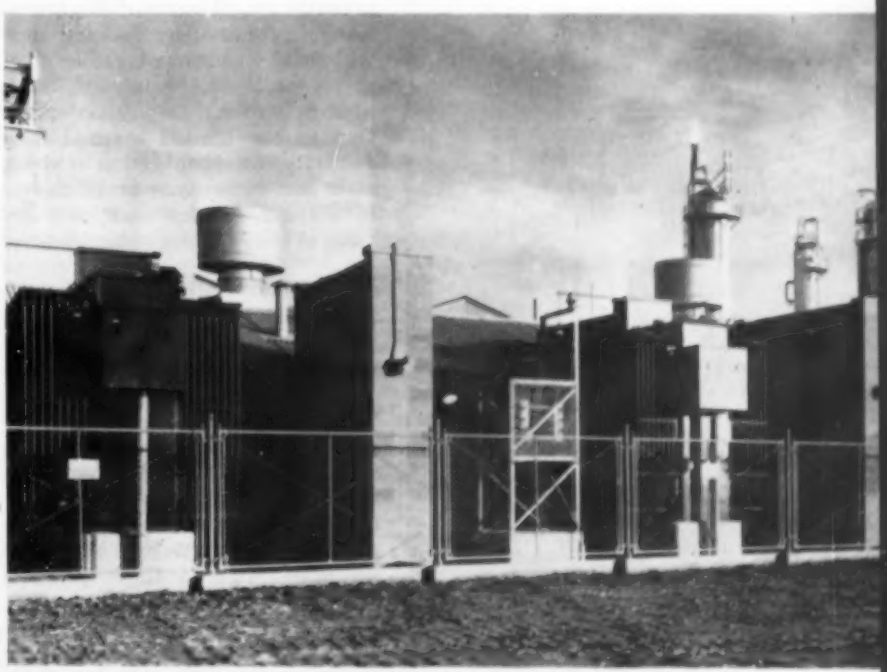
Type of connections?

A large transformer normally will have primary and secondary bushings in the cover for open connection of bus bar or single conductor wire or cable. If open connections are to be avoided, however, or if for other reasons multiple conductor cables are to connect directly to the transformer, provision for such connection must be prearranged in the form of enclosed bushings or pothead connections. Be sure that the bushings you get do not have metal parts incompatible with any unusual corrosive conditions to which they may be exposed. Any metal parts not of copper should be bronze.

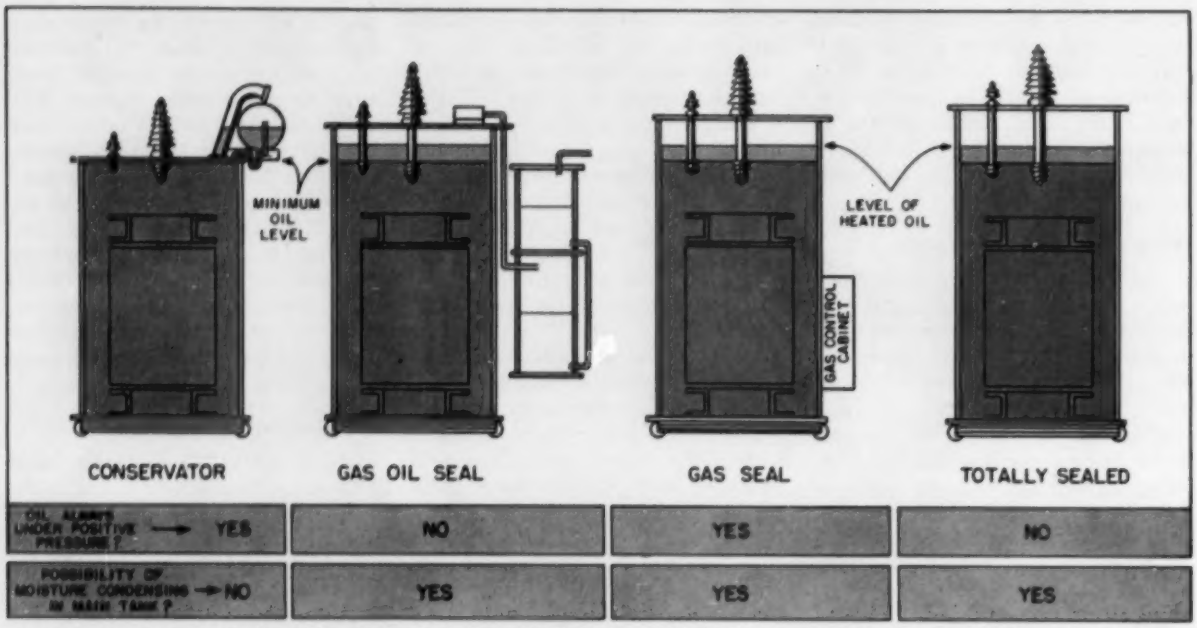
Standardization for you?

Much work has recently been done by manufacturers and technical organizations in standardizing transformer designs and parts. It may be necessary, therefore, to decide whether the new transformer is to be designed and built in accordance with new standards or as a duplicate of older transformers already on hand. The spare parts angle, particularly for replacement bushings, will influence this decision.

In power transformer sizes, the air-over-oil transformer is about as obsolete as the Model T. Hot oil in contact with air deteriorates

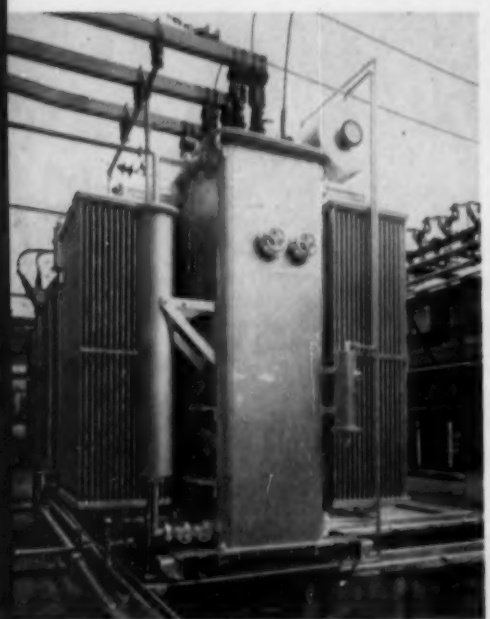


These three-phase units, each rated 7500/9375 kva, supply compressor motors in chemical plant. Notice the masonry barrier walls between the transformers.



Four common types of oil cushion protection, three of which are sealed against entry of moist air, which could condense. Comparative advantages, and costs of achieving them, should be analyzed carefully to get best transformer buy for you.

rapidly. This contact is usually avoided, therefore, in one of two ways. The simplest is probably the conservator tank, which is mounted above the transformer and connected to it by a small pipe. This tank will have a volume about three to five percent of the oil capacity of the transformer. It will be maintained about half-full at normal ambient temperature. This allows plenty of room for the level to rise or fall with temperature changes and still maintain positive pressure on all parts of the transformer proper. Any leakage thus will be of oil outward, rather than of air or moisture inward. Such leakage will be readily observed. Due to the limited thermal conductivity of the connection between main and conservator tanks, the oil in the conservator tank will remain at near ambient temperature.



Provision of castors simplifies moving transformer, saves maintenance time.

Nitrogen blankets oil

The other common method of protecting oil in a transformer is by maintaining a blanket of nitrogen over it. In a transformer designed for this type of oil protection, an open space is left above the oil, as in the older transformers. This space is kept full of nitrogen by bleeding the gas into it from a pressure tank through a regulator set to maintain a slight positive pressure.

Expansion of oil causes the nitrogen to be vented to the air when the set pressure is exceeded. Contraction of oil causes nitrogen to be drawn from the tank. A relay is available to give an alarm when pressure fails due to a leak or exhaustion of the nitrogen tank supply. One modification of this arrangement is the oil-sealed inert-gas system, in which the gas space is purged of air by nitrogen. This nitrogen is retained by a seal tank of varying volume.

All of these systems are effective in protecting the oil. The first one we described appears to have advantages from the standpoint of simplicity. Also, the conservator type permits the use of gas relays, which the inert gas type does not. Some transformers are now being furnished completely sealed and with a cushioning nitrogen-filled space left in the top. This, of course, calls for careful consideration of the pressures which may be developed and of the design of the transformer tank to withstand these pressures.

Cover styles?

If the cover has manhole entrances and adequate crawl space for internal inspections, and if you anticipate returning it to the factory when and if major repairs are required, you may want the cover welded in place. This will eliminate

leaks at this point. However, if you expect to untank it on your property, or if manhole entrances or crawl space are not provided, a bolted cover with reuseable synthetic rubber gasket would be your choice.

If the transformer can be handled entirely by crane, there will be no justification for paying for wheels. If it must be rolled into place, you will want a wheeled truck under it. If the wheels cannot be rotated 90 degrees in the truck, the direction of travel with respect to the long and short axes of the transformer should be specified. Transformers can be skidded on greased rails or moved on pipe rollers satisfactorily over short distances.

Lightning protection?

Whether the transformer will require its own lightning protection, and whether the insulation level for the primary winding will require special consideration, will depend on the primary voltage and the system to which the transformer is connected. Consult your transmission engineer or engineers of the utility serving you.

There are a number of auxiliary devices to consider, some of which may be standard and some optional. You should know what you want:

¶ Top oil temperature indicator (with or without alarm contacts).
¶ Winding temperature indicator (or recorder, or alarm, or tripping relay).
¶ Flowmeter (if transformer is water-cooled).
¶ Fans for additional air cooling.
¶ Heat exchanger for external air or water cooling, with pump.
¶ Oil sample valve, from *bottom* of transformer.
¶ Oil drain and filling valves.
¶ Connections for future activated alumina or Fuller's earth treater (for use when oil oxidation inhibitors are exhausted and neutralization number has started to increase).
¶ Desiccating breather (if not nitrogen covered).
¶ Gas relay, for detecting faults in formative stage or indicating when a tripout is due to an internal fault.
¶ Pothead, if transformer is to have cable connections.
¶ Flexible connectors, if bus bars will be connected to bushings.
¶ Radiator valves, if radiators are removable.
¶ Pressure relay (also a fault indicator).
¶ Pressure release disc or valve (explosion relief).

Other items for consideration that are associated with the transformer but are not a part of it are primary and secondary switchgear; overload, directional, or differential relay protection; fire protection in the form of water spray, fog, or CO_2; transfer car and tracks for moving transformers; basin under transformers full of large rocks to receive and cool oil in case of spillage and fire; oil storage tank, filter press and Fuller's earth or activated alumina treater for reduction of acid content; and megger for insulation testing.

Most manufacturers are offering a preassembled combination of transformer and switchgear in the form of a unit substation. This offers advantages in saving installation time and space. Such an assembly should be considered if switchgear is needed in connection with the transformer. The unit substation is particularly attractive for indoor installation near the utilization point. Information given here, however, is aimed principally at the purchase of transformers having greater capacity and higher voltage than would probably be used in an indoor load center.

How to test battery condition

CORRECTION CURVES just developed can make your battery check testing procedure much simpler and cheaper. These curves show the relationship of battery capacity to life expectancy. The test discharge will give battery capacity from which can be determined battery life. As battery capacity approaches 80 percent, the rate of decrease in capacity is sharper. When capacity falls below 80 to 85 percent, it should be watched carefully and plans made to replace it.

First the battery is given a normal charge at usual rate. It is then given an equalizing charge at finishing rate until there is no increase in specific gravity, and all individual cells are uniform. They must not differ from each other by more than .020 nor register less than 1.250. Specific gravity of each cell is taken, and an average calculated. Average temperature of electrolyte is also determined and recorded, as well as average room temperature.

Battery is discharged, at the six-hour rate, no later than 16 hours after equalizing charge, into a resistance load such as a grid, carbon pile, or water-barrel discharge unit. It is important that the discharge rate be maintained steady at correct value. Voltage across each cell should be read and recorded every hour up to the fourth hour and every half hour after that. Time of starting the test should be accurately noted. When the first cell of the battery shows a voltage of 1.75 volts, the test discharge should be stopped and time noted. It is assumed that all cells will approach 1.75 volts simultaneously. However, if one cell reaches that point before the others, it should be shorted out, and the exact time recorded. Select one cell as a pilot. In addition, recording voltage of each cell for six hours will indicate which cell is most likely to reach 1.75 first.

What we are trying to determine is how close to six hours the battery maintained a voltage of at least 1.75 across each cell. Corrections must be made for the difference in specific gravity of the battery at the start of the test in a fully charged condition from 1.275, and for temperature difference that exists above or below 77 F.

K. A. Vaughan,
National Service Manager,
Gould-National Batteries, Inc.

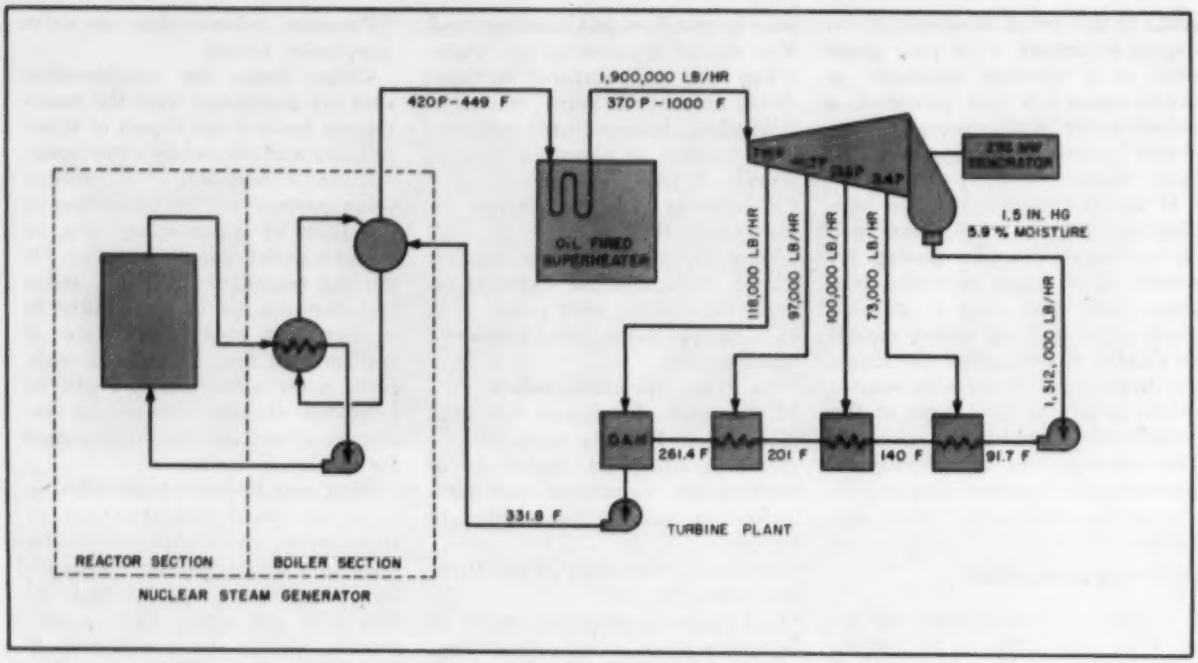


Fig. 1—Typical proposed nuclear steam power plant cycles will use a boiler drum, probably with an oil fired superheater.

What NUCLEAR power will mean to power plant AUXILIARIES

I&P EXCLUSIVE

I. J. KARASSIK and T. W. EDWARDS
Worthington Corporation

EXCEPT FOR certain deviations, the secondary circuit of your nuclear steam power plant will differ very little from the steam and feedwater cycles of your conventional power plant operating in the same pressure and temperature range. Certainly, these pressures and temperatures will be considerably lower than those commonly encountered today, even in the smaller sized steam generating units rated 10,000 or 20,000 kw.

The nuclear power plant does not have a "furnace" as we now know it. Some installations may even dispense with a drum. The "boiler" would become a heat exchanger with once-through flow. On the other hand, many illustrations of proposed nuclear steam power plants do indicate that a boiler drum will be used (Fig. 1).

Conventional cycles

In all conventional steam and feedwater cycles, steam is exhausted from the turbine, is then condensed in a condenser, and is then pumped through a series of heaters to the boiler feed pump. This delivers feedwater via more heaters to the boiler. Here it is evaporated, superheated, and sent to the turbine inlet to complete the cycle.

Consider the various components of the secondary circuit, starting at the lowest pressure point (the condenser). We find that at the throttle flows presently envisioned for nuclear power plants, condensers and their auxiliaries are apt to be somewhat larger than those generally used today for the same kw rating. This follows because steam flow per kw increases at lower throttle pressures. More condenser surface is required. This tendency may be largely nullified; ultimately, even the reverse may come true. Lower-cost fuel may make uneconomical the high condenser vacuums generally considered necessary for economical operation in conventional cycles.

When any one of the feedwater heaters used in a conventional

steam power plant is of the direct-contact type, it is located at the suction of the boiler feed pump. This cycle is said to be an open cycle (Fig. 2). Feedwater deaeration takes place in the heater. If all the heaters are closed heaters, then the cycle is said to be a closed cycle, (Fig. 3). Here, all deaeration must occur in the condenser.

Indications are that feedwater purity will be of the utmost importance in nuclear power plants. The desire to use conventional materials wherever possible, for economy reasons, requires complete deaeration so that minimum chemical treatment is necessary. Deaeration must be rigidly controlled. Latest information indicates that certain stainless steels used in the nuclear heat exchanger which replaces our conventional boiler may require a very minute trace of oxygen (rather than complete absence of it) to obtain full protection against corrosion. Whether or not such rigid control of oxygen in the feedwater at all loads can be as easily accomplished in a condenser deaerating hotwell as in a deaerating heater remains to be seen.

Will have open cycle

We suspect that the nuclear power plant will employ, at least for the present, an open feedwater cycle. As in conventional power plants, some feedwater will be lost to the cycle through glands, seals, and so forth. Therefore, as in conventional power plants, makeup will have to be introduced into the cycle. It would appear for the moment that demineralizers, rather than evaporators, will be employed to supply this makeup because of the greater purity obtainable, and because of the better CO_2 removal that can be accomplished.

Feed pumps in conventional plants

To better understand the problems imposed upon the boiler feed pump in nuclear power plants, let us first examine the application of feed pumps to conventional steam power plants. Selection of total installed feed pump capacity (outside of standby equipment) is dictated by the necessity of providing margins for swings over and above maximum boiler rating, and of compensating for ultimate wear in the internal clearances of the pump. Since maximum boiler rating is generally selected well above maximum turbine throttle flow, it is apparent that the pump design capacity will exceed this turbine throttle flow by a very appreciable percentage.

In selection of discharge pressure at rated conditions, a substantial margin is similarly included. This pressure must be sufficient to overcome the sum of rated steam throttle pressure, losses between superheater and turbine, friction loss through the superheater, losses through all regulating feedwater valves, piping, closed heaters and so on, and static head from pump centerline to boiler drum. A generous safety margin never fails to creep into the picture. These figures must be estimated well in advance of equipment installation. Thus, even for the maximum load that the turbine can carry, both pump capacity and total head are always much in excess of that required. Some means of adjusting pump delivery to boiler requirements must be provided.

In the case of pumps operating at constant speed, this function is fulfilled by the feedwater regulator, which is nothing but a throttling valve made automatically responsive to external impulses. In large central power stations, a three-element regulator is generally employed. The three elements or impulses are steam flow, feedwater flow, and boiler drum level. Meters are provided for steam and water flow. Controls are adjusted to weigh one against the other. The level impulse trims the feedwater regulator to maintain a reasonably even boiler drum level after changes in load.

Power plant loads are by nature of a variable character. As load is reduced, the feedwater regulator closes to prevent overpumping into the boiler drum. Excess pressure developed by a pump operating at constant speed is throttled. A look at a chart representing the pump head-capacity curve at constant speed and the system-head curve of a given installation shows that head capacity rises appreciably with a decrease in flow (up to 20 percent). System head decreases in the familiar parabolic shape of all curves with a frictional component.

Excess head throttled by the

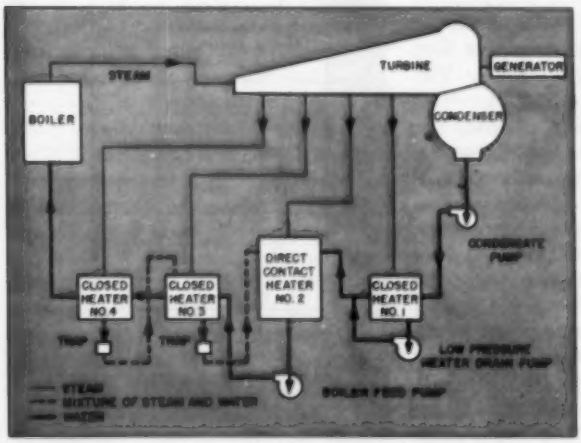


Fig. 2—Open cycle has direct contact heater on feed pump suction. Drains are cascaded to lower pressure heaters.

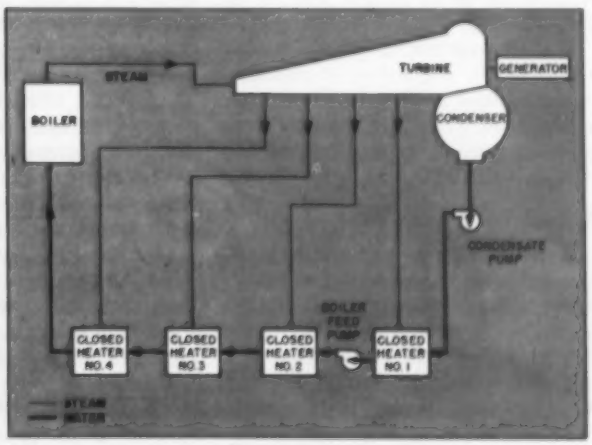


Fig. 3—Closed feedwater cycle has no direct contact heater, so all deaeration must take place in condenser.

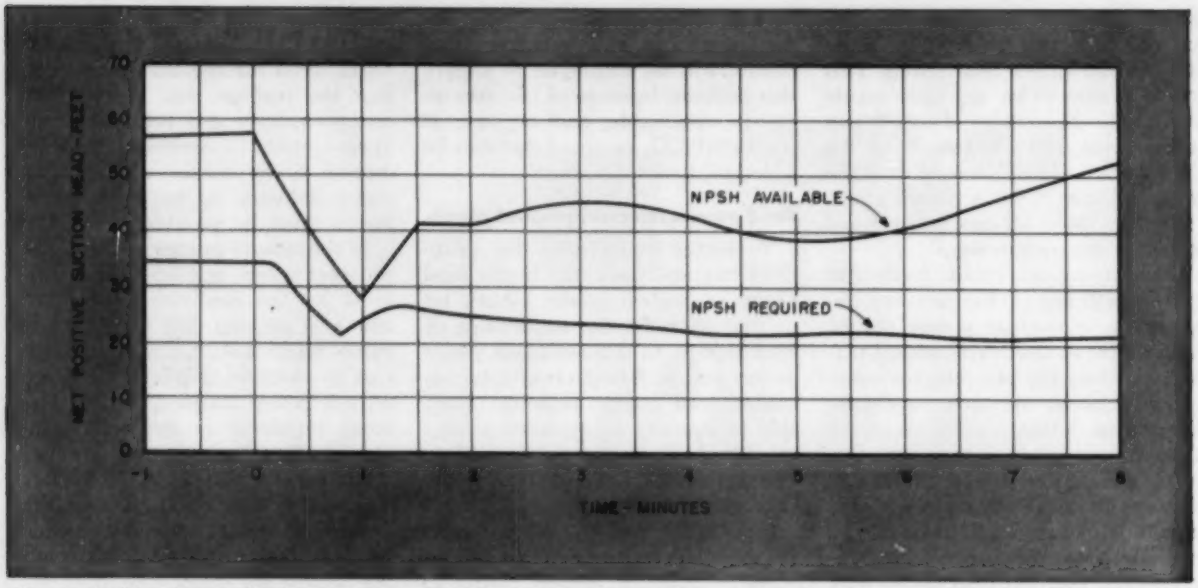


Fig. 4—Sudden drop in load in conventional steam power plant reduces margin between available and required NPSH.

feedwater regulator is wasted. This is of little consequence in a small power plant, but quite uneconomical in larger units. The tendency, therefore, is to substitute variable speed operation for constant speed drives. This makes the pump head-capacity curve conform more nearly to the system-head curve and reduces power consumption. Variable speed can be obtained through the use of turbines, or by interposing a variable speed device (such as a hydraulic coupling) between the pump and a constant-speed squirrel cage motor. Hydraulic couplings are by far the more prevalent means of providing variable speed today. Power plant designers have looked on the steam turbine drive with little favor in the last 10 or 20 years.

If the feedwater cycle still retains a feedwater regulator, it remains in essentially a wide open position at all loads. Loss through it is kept to a minimum, regardless of the feedwater flow.

System head in nuclear plants

Our nuclear power plant does not have the same system-head characteristics as the conventional power plant. The unit has been endowed with protective characteristics which will prevent the reactor from "running away." Rate of heat flow into the heat exchanger serving as the boiler is largely independent of station load, because neither flow on the primary side nor heat output of the reactor vary. Since this heat must be carried away at a constant rate, a temperature rise is permitted. Consequently, steam pressure generated in the heat exchanger rises with a decrease in load. This has the same effect as if we had arranged our conventional power plant to have a boiler pressure that rises with a reduction in load.

The effect is essentially the same in principle, if not in degree, as used to take place in large stoker-fired boilers—where the enormous quantity of heat stored in furnace and boiler caused a rise in boiler pressure and an appreciable shrinkage in the boiler drum on decrease in load. Such exaggerated shrinkage and swell will no doubt occur in nuclear power plants that embody a boiler drum (as in Fig. 1). Special attention will have to be paid to this effect during the transient operating conditions.

The exact value of pressure rise from full-load to no-load in a nuclear power plant is still uncertain. Many opinions have been advanced, ranging from a 30-percent value to as high as 100 percent. No doubt, the high value is much exaggerated, and 40 to 50 percent probably will be found to be about right. But since there is no full scale prototype nuclear power plant in operation today, much information on this phase of our problem is yet to be developed from experience. Furthermore, different reactors may have different pressure rise characteristics. We may well face a variety of system-head shapes before we are through.

System-head speculation

If we remain for the moment in the realm of qualitative rather than quantitative speculation, we may assume that the rise in the system head from full-load to zero flow will exceed the average rise in the shape of the conventional constant speed head-capacity curve for a

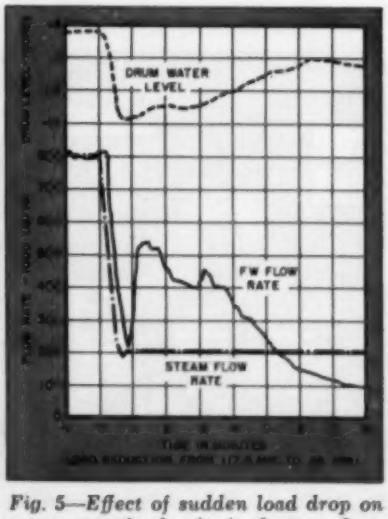


Fig. 5—Effect of sudden load drop on conventional plant's feedwater flow.

centrifugal pump. Therefore, our pump will have to be selected for a given minimum shutoff head, and develop whatever excess head at design capacity the system characteristics impose. We now have the paradox of having to throttle the discharge of our pump at full load more than at reduced loads. This paradox is not very attractive, since our throttling losses will now occur at those loads where we want to have our best overall economy. It would appear, therefore, that variable speed operation is a decided "must" in the case of large-size nuclear power plants served by centrifugal pumps.

Hydraulic coupling in doubt

We must remember that the hydraulic coupling will not necessarily show up as well in nuclear installations as it does in conventional units, because of losses inherent to the coupling itself. After all, these losses are directly proportional to slip. Speed reduction at full load may be an important item. For this reason, it will be advisable to reexamine the steam turbine's application to the boiler feed pump drive in nuclear power plants. Essentially, the pump and its drive can be selected for optimum speed at the rated conditions, a rise in turbine speed *above* rated speed providing for the rising system-head curve. It is only necessary then to select a pump and turbine capable of operation at the necessary overspeeds.

A further difference between the conventional cycle and the secondary side of a nuclear power plant cycle is in the matter of transient operating conditions (operation during periods of rapid load changes). In a conventional cycle, momentary drum shrinkage upon load drop causes boiler feed pump flow to increase for a short time before it assumes a flow equal to the lower throttle steam flow corresponding to the lower station load, (Fig. 5). This occurs at the same time that the deaerating heater pressure drops. This heater pressure drop, without a corresponding immediate feedwater temperature reduction at the pump suction, reduces the margin between available and required NPSH which would exist during periods of stable operation. At the same time, the required NPSH of the feed pump increases due to the momentary increase in feedwater flow previously mentioned, (Fig. 4). It is the interaction of these two opposing conditions that sometimes causes operating difficulties during periods of rapid load changes. In a nuclear power plant embodying once-through steam generators, this problem, although still existing, is not quite so severe. Since feedwater flow follows steam flow exactly and there is no drum shrinkage to be dealt with, there is no momentary increase in required boiler feed pump capacity. Some of the problem is then removed.

On the other hand, if the nuclear power plant embodies a heat exchanger and a boiler drum, such as illustrated on Fig. 1, drum shrinkage coincident with reduction in load will be much more marked. The problem of transient operating conditions will be even more severe than in a conventional steam power plant. It would appear necessary, therefore, to provide some protective controls at the direct contact heater, such as antiflash controls, to prevent the pressure decay rate in the heater from exceeding the allowable decay rate.

Feed pumps for nuclear plants

Let us look briefly at the general type of centrifugal feed pump that would be applicable in the nuclear power plants envisioned today. Since steam pressures, for the moment, are limited to about 850 psig, a horizontally split casing design (good for discharge pressures up to 1300 psig) would be used. Such a pump would be made of all stainless steel construction, and would be very similar to present day designs applicable for the same boiler pressures in conventional plants.

For pilot-type installations as well as for small units — say under 7500 kw — the direct acting power pump presents an ideal solution to the problem of the rising system-head curve. Changes in capacity can be accomplished by use of a variable speed device or by use of a variable stroke design, while changes in discharge pressure are accommodated by the inherent characteristics of the power pump.

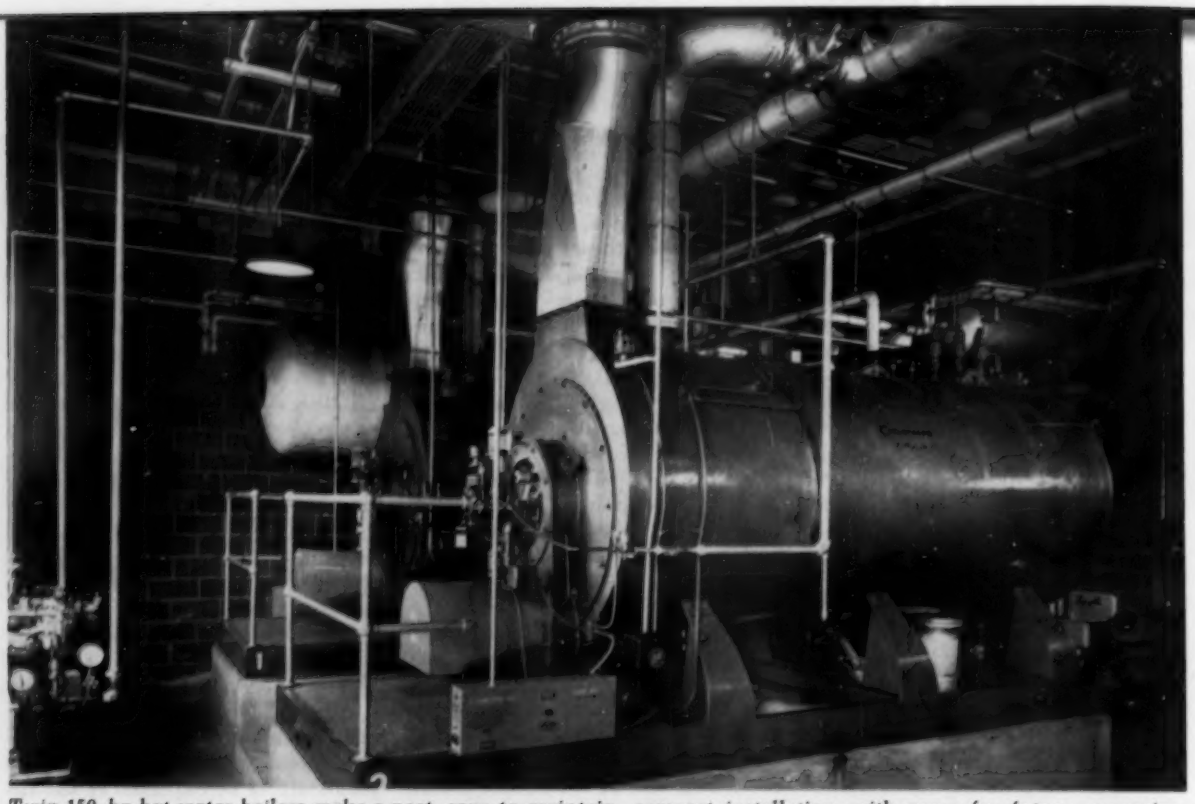
Pressures will increase

It must be remembered, however, that increased steam generator pressures in nuclear power plants are to be expected in the future. As these pressures advance beyond about 1000 psi, the barrel-type pump can be expected to replace the axially split casing design. These barrel pumps would be similar to those in wide use today in large, modern central stations. It is very probable that this transition to higher pressures in nuclear power plants will be much more rapid than it was in conventional cycles. Where it took about 20 years in the past, it is safe to assume that nuclear power plants will reach higher operating pressures within the next five or ten years.

Wrought iron for condensate service

Selection of a corrosion resistant material likely to provide long and satisfactory service entails consideration of the physical properties of metals and their performance in actual installations. On both counts, wrought iron piping has proved a logical choice for condensate service. A unique two-component metal of high purity iron and iron silicate, it is especially adapted to corrosive service. The purity of the iron itself, plus the protection afforded by the iron silicate (glass-like slag fibres that will not corrode) combine to give the material a high measure of corrosion resistance.

Data compiled by the Engineering Service department of A. M. Byers Company reflects the long-life potential of wrought iron in steam condensate lines. Service records covering periods of 60 to 75 years testify to the metal's outstanding performance in actual installations. Even more numerous are steam condensate line service records embracing spans of from 30 to 50 years.



Twin 150-hp hot water boilers make a neat, easy-to-maintain, compact installation, with room for future expansion.

BETTER boiler circulation helps Hot water HEATING SYSTEM

I&P EXCLUSIVE

HENRY J. JANSSEN
President
Child & Scott, Inc.

FORCED CIRCULATION hot water for space heating offers simplicity, flexibility, and compactness in the new John Hassall, Inc. plant in Westbury, Long Island. The entire plant is housed on one floor of the 300-foot by 296-foot building, with the office on the mezzanine. It was impossible to depend on gravity flow for heating purposes because of the size of the building. Child & Scott, the heating contractors, selected two Cyclotherm 150-hp hot water boilers to supply the system.

One of the boilers, operating on No. 6 fuel oil, is capable of handling 70 percent of maximum full load. The two boilers together, then can give the owner 40 percent more power than his present maximum loadings may require. Usual procedure is to operate one boiler for the entire load, with the other as standby unit.

Package boilers were chosen because for high efficiency, dependability, and single defined responsibility for boiler procurement. Appearance was a prime factor in the plant's construction. Package steam generators eliminated the need for a tall stack and contributed to the desired low plant silhouette. The boilers are used year round, since they also provide hot water for process and domestic use.

Water flow and return tappings on the two steam generators were arranged according to specifications by Child & Scott. The flow line is located at the bottom of the boiler as close to the rear of the Cyclotherm unit as possible. This reverses normal boiler flow and insures complete circulation of the water throughout the boiler. It avoids "short-circuiting" — return water flowing directly to outlet without traversing entire length of boiler.

Both boilers are mounted on pedestals 24 inches high to provide room for installation of 8-inch valve piping connections beneath the boilers. Settings are not solid. They are 12-inch thick walls on concrete footings. These pedestals make

maintenance easy and avoid underground piping.

All piping throughout the plant is above ground. It was necessary, however, to bury about 12 inches of the fuel line at the point where it enters the building.

Fuel oil storage consists of two buried 10,000-gallon tanks. Remote fuel pumps are mounted on 36-inch pedestals. This mounting arrangement gives easy accessibility. (Fuel pumps are normally mounted directly on Cyclotherm units but were set up separately for this installation.)

The entire heating system is divided into six zones, each with separately controlled pumps for radiation heating. A seventh zone is provided for unit heaters. Duplicate circulating water pumps with motors rated five horsepower are provided for the unit heater zone. Radiators are located near exterior walls to take care of heat losses to the outside. Unit heaters are placed in interior locations to make up the difference between heat generated by plant equipment and heat required for space heating. Five of the heating system zones are fin-tube zones. The sixth is a hot water storage tank zone.

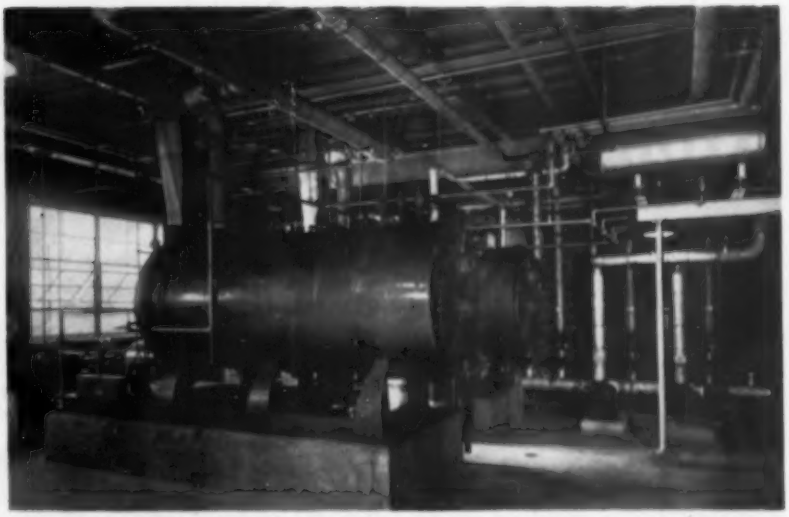
Hot water circulation controlled

Hot water from the boiler at 225 F and 25 psig circulates throughout the seven zones. An automatic timing mechanism lowers building temperatures when unoccupied.

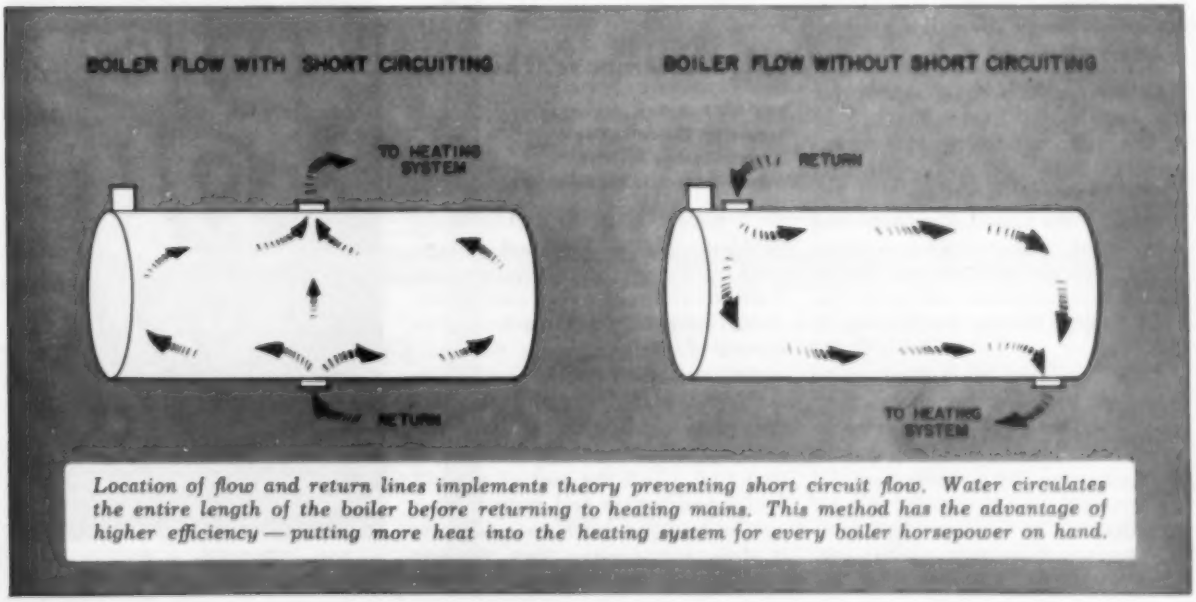
Perimeter heating with Vulcan fin-tube radiators is provided under the long expanse of windows in the shipping room, machine shop, and production machine rooms. Each room is large enough and is so oriented as to warrant its own zone control. Inside toilets and locker rooms are heated by fin-tube radiation, being part of the shipping room zone.

Unit heaters, each under individual thermostatic control, are provided in the machine shop, production machine rooms, plating room, heat treatment room, and warehouse sections. Bare branch mains are located below the monitor windows in order to avoid downdrafts. Roof monitor spaces are also warmed by unit heaters.

This system simplifies installation, gives more usable space in the boiler room, and allows for future expansion. The installation is typical of the present trend toward compact package boiler units — packing more power in less space.



Flow line location at bottom rear of boiler prevents short circuiting of boiler flow and insures maximum possible heat recovery from circulating medium.



Location of flow and return lines implements theory preventing short circuit flow. Water circulates the entire length of the boiler before returning to heating mains. This method has the advantage of higher efficiency — putting more heat into the heating system for every boiler horsepower on hand.

In brief....
Atomic Energy Forum and Fair

SOME 1200 people attended the Atomic Industrial Forum's recent meeting on Commercial and International Developments in Atomic Energy. Running concurrently was the first U.S. Trade Fair of the Atomic Industry, which drew 7500 people. The Conference, held with participation of the American Nuclear Society, was permeated by an atmosphere of impatient excitement for the future, a carryover of the enthusiasms generated at the Geneva Atoms-for-peace conference held in August.

This gathering, as described by Forum executive manager Charles Robbins, demonstrated how close industry must stay to the scientists in the atomic energy business. The tone of the sessions gave the impression that industry was in the process, at these meetings, of taking over the reins from the scientists in commercial development of atomic energy.

Timely and important sequel to Geneva

Lewis L. Strauss, Chairman
U.S. Atomic Energy Commission

"I should like to be permitted to congratulate those responsible for the first United States Trade Fair on the Atomic Industry. It is an impressive exposition and I wish that every American might see it, for it illustrates the vision, ingenuity and determination of private enterprise to advance the nuclear art. It is a timely and important sequel to the First Atomic Energy Conference in Geneva.

"The fact that we appear to be ahead in the peaceful applications of atomic energy—perhaps by a scant few years—certainly offers no justification for complacency. To the contrary, the situation must be regarded as a serious challenge. The Soviets have not outstripped nor equalled us in any peaceful application, but at the same time—and this is important—we did not show anything at Geneva which they cannot have in a few years, given the talent and zeal which we believe them to possess. . . .

"We, in the United States, are fortunate in that we face no urgent shortage of conventional fuels. We have time and the opportunity to attack the problem from every side, and to experiment simultaneously with a whole variety of atomic power systems. That is exactly what we are doing. Last week the Commission took another step forward and invited proposals from industry and other groups for the design and construction of small atomic power plants. This marks the second round of a partnership program designed to speed the development of efficient, economic nuclear power. Our first Power Demonstration Reactor Program began, as you know, earlier this year and produced proposals for large plants. American industry is dedicating risk capital in a conservative race to produce the best and most efficient means of atomic power—knowing full well that the first plants will not be economic."

Fuel and component business

Stanley B. Roboff, Manager
Industrial Coordination
Atomic Energy Division
Sylvania Electric Products, Inc.

"I have chosen to highlight the problems of the fuel and component businesses for several reasons. First, as virtually every cost breakdown for generating electricity by means of nuclear power has indicated, one of the major cost items is that associated with the manufacture of the nuclear fuel and the subsequent chemical reprocessing of that fuel. Until the cost of nuclear fuel manufacture and reprocessing can be brought down considerably, it does not appear that nuclear power will be competitive with power from conventional power plants for many decades to come, at least in most of the populated areas of this country.

"Secondly, the entire cycle of fuel manufacture and fuel recovery seems to have been somewhat overlooked in the scramble of a large number of industrial concerns to be the "first in their block" to build a commercial power reactor. Within the past few months, key members of the Atomic Energy Commission staff have repeatedly pointed out, that until industry solves the combined problems of spent fuel reprocessing and refabrication, economic nuclear power will stay out of reach.

"Thirdly, whereas the construction of a large number of major reactor components can be accomplished in existing plants and mills of the present industrial suppliers of generating and boiler equipment, a concern engaged in the manufac-

A. Iddles, Babcock & Wilcox, shows AEC Commissr. Libby fuel elements.

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Atomic Energy Forum and Fair

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ture of nuclear fuels and reactor components, and more particularly the recovery of highly radioactive spent fuels, must undertake his activities in a type of facility which is almost nonexistent on the American industrial scene."

Selling nuclear steam

John W. Landis
Atomic Energy Division
The Babcock & Wilcox Company

"True, most of us are slightly daft over the prospective peacetime uses of the atom, but I do not believe we would have carried on as we have through the past year were it not for two other factors:

"1. the decision of an unexpectedly large number of companies to enter the reactor equipment field, and

"2. the decision of an unexpectedly large number of utilities, industrial firms and nonprofit organizations to look into the feasibility of building a reactor. . . .

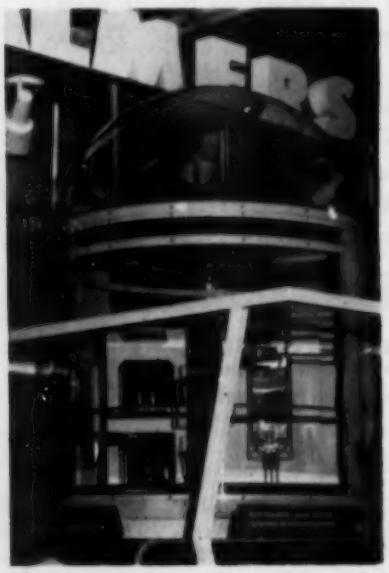
"Up to now, most nuclear customers have come directly to the equipment manufacturers active in the field and asked for recommendations regarding what type of plant should be built and a firm price proposal to boot. Naturally, each equipment manufacturer has recommended the type of reactor with which he is most familiar. This may or may not have been the best reactor for the application in question. The experience of any one equipment manufacturer is still insufficiently broad to permit him to make this decision properly. Nor can the customer spend the time and money required to compare widely different designs suggested by different suppliers.

"Thus, reactor jobs to date have largely gone to the firms with the best engineering-sales teams and the most crystallized reactor designs. And this is undoubtedly as it should have been. In no other way that I can think of could the atomic industry have been started off as fast as it was. I am not regretting anything that has happened. On the contrary, I think everyone in this field should have a great sense of accomplishment in retrospect.

"The job now, however, is to prepare for the long haul. Nuclear power is not a five-year deal nor a ten-year deal. You know from reading the predictions of Doctors Davis and Lane of the Atomic Energy Commission and of such industrial leaders as Francis McCune of GE, in addition to the excellent market survey recently put out by the Atomic Industrial Forum, that the real rush for nuclear power equipment will not begin for another ten years yet. Since we are already somewhat over our heads equipment-wise, therefore, let us take a look at what should be done to rectify the sales situation.

"First of all, I believe that buyers should do something which is quite natural at this stage of the game and that is to await and carefully evaluate the results of the reactor projects now being carried out under the AEC's Five Year Reactor Development Program. They should also take a good hard look at the official AEC reaction to the nuclear power plant license applications now in its hands. . . .

"This leads me to my second suggestion: Both buyers and suppliers in the nuclear field should make every effort to utilize the architect-engineering firms in the way that they are now utilized in the conventional power business, namely, as the customer's agent and advisor and designer of the overall plan.



Allis-Chalmers displayed this model of Argonne Laboratory's reactor plant.

Management appraisal of atomic activities

Major General K. D. Nichols (Ret.)
United States Army

"Probably first of interest in the whole field of atomic activities is the atomic power industry. I happen to be among those who believe that the use of atomic power will continue to expand and will ultimately furnish a large proportion of the electric power needs of the world. As the electric requirements increase, the price per kilowatt for power derived from fossil fuels and from the remaining hydraulic sites will tend to rise; as a result of this rise atomic power will become more and more competitive and will provide a larger and larger percentage of the newly installed capacity. . . .

"A second type of management appraisal problem pertains to those industries who have in the past and who are interested in the future in supplying the utilities and industry with equipment and plants for producing electric power.

"A third type of management appraisal problem pertains to those companies who have in the past been large users of electric power and whose position in the supply of their basic commodity is influenced by the price of power. These industries in the past have located their plants in low-cost power areas. They must appraise the possibilities of atomic power, determine when it will become economically competitive with other sources of power, and must determine if these new sources of power has an influence on the sitting of various components or their production chain.

"Atomic energy may offer possi-

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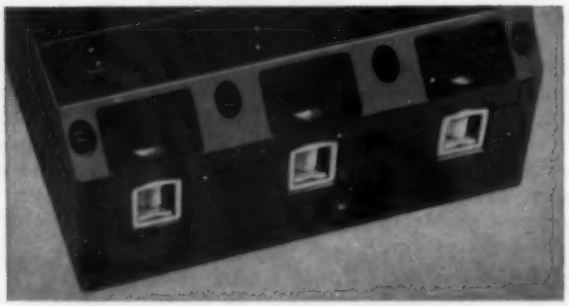

1. Enclosed terminals. Provide maximum safety to personnel, yet permit ease of cable connection. All 600 v a-c rated I-T-E molded case breakers have enclosed line and load terminals.

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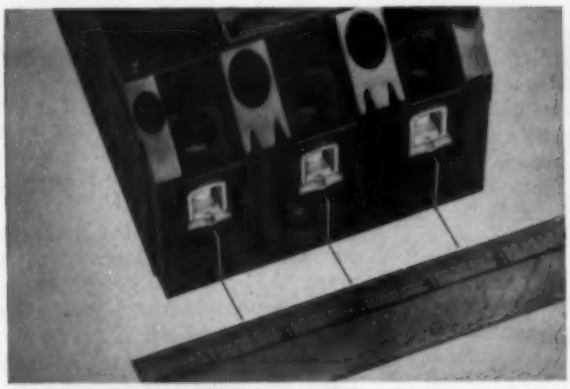

3. Greater terminal clearance. I-T-E molded case breakers are designed on multiple 1½" pole centers to provide maximum phase to phase spacings and reduce electrical leakage clearance problems.

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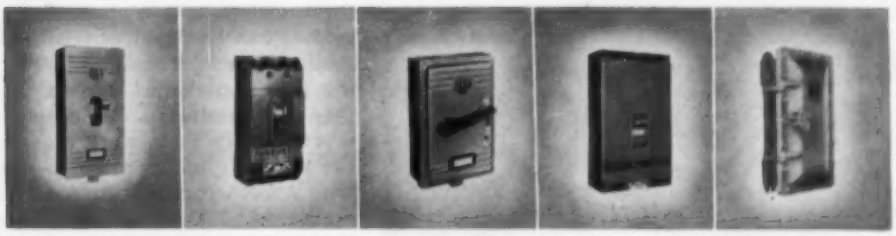

5. A complete line. I-T-E manufactures a complete line of commercial, Navy and maritime molded case circuit breakers 10 through 600 amp, 600 v a-c, 250 v d-c. All are available with various special features and in all types of individual enclosures.

Contact your I-T-E representative or authorized distributor for the Speedfax Catalog—containing complete information on all I-T-E circuit breakers and enclosures. Or, if more convenient, write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

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Atomic Energy Forum and Fair

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bilities of moving the source of power to more desirable locations as compared to the inflexibility of available hydraulic sources or cheap coal or gas. As illustrated by the Army Power Package Plant, atomic power may have economic advantages in remote sites when other cost factors are considered. Other applications such as utilization of atomic reactors for process heat and marine atomic power fall in this general category and are either still largely unexplored or from an economic competitive point of view are still in the more distant future."

Responsibilities for reactor within a city

William M. Cousins, Jr.
Armour Research Foundation

"The owner of a reactor faces a serious legal problem, which, as you all undoubtedly know, still is unresolved. Certainly it is clear that the owner must assume full legal responsibility for his installation. This has been made manifest by AEC repeatedly. Legal responsibility rests largely on the insurance problem. . . .

"The two basic problems involved are the assessment of the damage and a calculation of the maximum possible damage. I obviously am not qualified to discuss the problem of assessing radiation damage. It is a medical and technical problem. However, I understand that possibly an acceptable method is by measurement of blood damage, and that there is a chance that proper standards might be devised by the medical profession to lead to some sort of quantitative evaluation of radiation damage. Certainly we are learning more and more everyday about radiation damage to living structures, and it does not seem too optimistic to believe that a quantitative measure can be achieved.

" The other two factors needed to establish a fixed limit of liability are the probability of a disaster and the population within its range. The latter should not be too difficult to determine, but the former requires experience, and I am well aware that such experience to date is slight. However, I feel it is not impossible that this slight experience, plus the estimates of experienced nuclear engineers, could lead to a figure acceptable to the insurance companies until further experience modifies it. . . .

We hope to [educate] the public through the publicizing of results obtained with the reactor, tours through the facility, radio and television programs, and other public relations techniques."

Design and economic aspects of packaged power reactors

Russell L. Hopping
Alvin F. Nehrenz
The Glenn L. Martin Co.

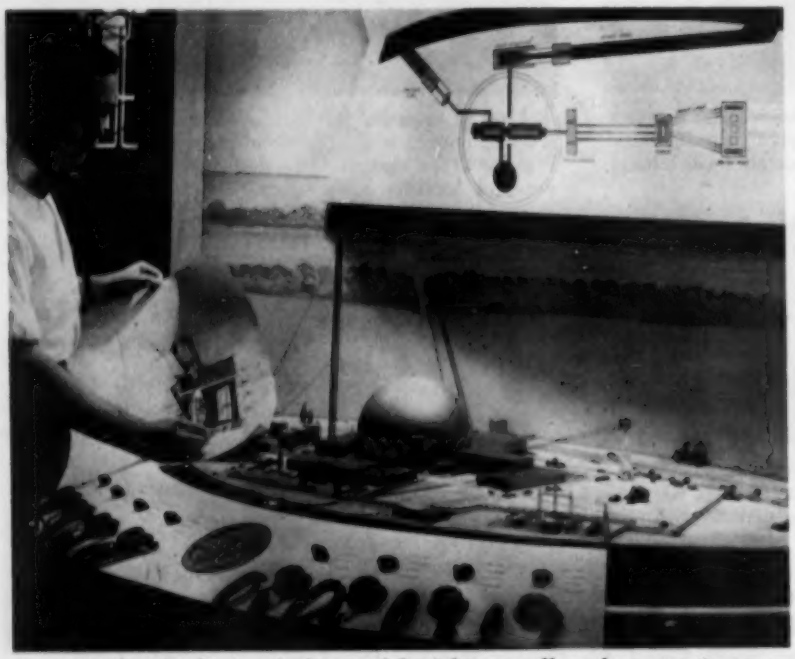
"It is obvious that the packaged reactor power source is not suitable for the needs of even a moderate-size industrial city. It does, however, offer a means of satisfying several other important requirements. Some of these are:

¶ To supply the initial power needed to start the development of regions that have difficult or unsolved problems with regard to the supply of fossil fuels.

¶ To provide an approach to essentially unattended power supply.

¶ To provide economically attractive power generation where the requirement is low and the cost of fossil fuel is high. . . .

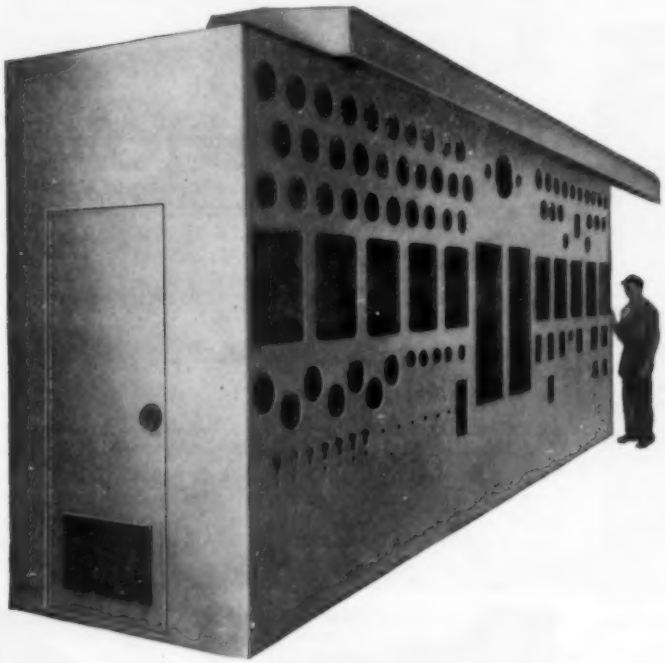
"A pressurized water reactor system can be developed with the small size and simplicity requirement of a packaged system. Further, the attainable efficiency and reactor design factors are such that the economy of operation permits it to approach competitive consideration with a number of current diesel-electric installations, even over a wide range of basic costs for U^{235} and a modestly assumed charge for reprocessing. It is evident that with an allowable capital investment on the order of $900 to $1100/kw, nuclear generated power can now compete with the highest cost diesel electric generated power in the United States today."



General Electric displayed this model of largest all-nuclear atomic power station — it will be built for Commonwealth Edison near Chicago.

Control Enclosures and Panels

fabricated by KIRK and BLUM



Whatever your requirements in control panels or electrical enclosures, KIRK & BLUM is equipped to fabricate them to your most exacting specifications. Whether it's a board with one or two instruments . . . or almost a hundred (as illustrated above) KIRK & BLUM has the experience and facilities to do a first-class job.

The control panels above, constructed for an electrical machinery manufacturer, are 20' and 28' long, 8'-6" high and 4'-8" deep. The body of the panel is constructed of ¼" steel plate, the light canopy above of ⅛" steel.

KIRK & BLUM will gladly quote on your requirements . . . one or a thousand units . . . any size. Send prints and specifications to The Kirk & Blum Manufacturing Co., 3174 Forrer Street, Cincinnati 9, Ohio.

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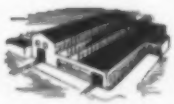
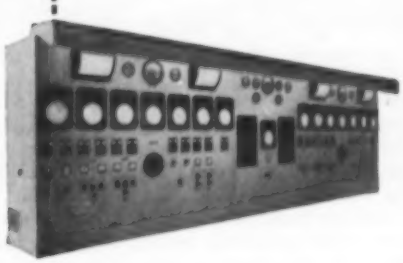


For Industry

Power Plants

and Utilities



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"Sheet Metal Assemblies"
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ideas in action

. . . for industry & power

Noise library in new sound laboratory

Library of noise will be one of the major results of a new sound-analysis laboratory recently completed by the General Electric Company at Fort Wayne, Indiana. Recordings of slightest murmurs from electrical transformers and motors will make up the noise library. Recordings will be used to compare various noises. Laboratory is a free-field chamber. All tests are made by remote control without any person in the sound room during testing. This

is because human body reflects a certain amount of sound and is incapable of remaining absolutely motionless and silent.

Building is constructed so that its walls are not parallel to any nearby structure. This prevents outside noises from reflecting back and forth between laboratory and other buildings. It also prevents subsequent buildup of sound energy from outside walls. Inside laboratory, sound testing chamber floats on steel springs and rubber shock absorbers. This prevents transmission of practically any ground vibration, such as would be caused by a passing train. To further isolate the room, walls are of eight-inch concrete, lined with three inches of flat mineral-fiber acoustic batting. Over this layer is another three inches of same material in the form of a giant washboard with ridges three feet deep. It covers entire inner surface of the room.

Insulation in reverse at Thule

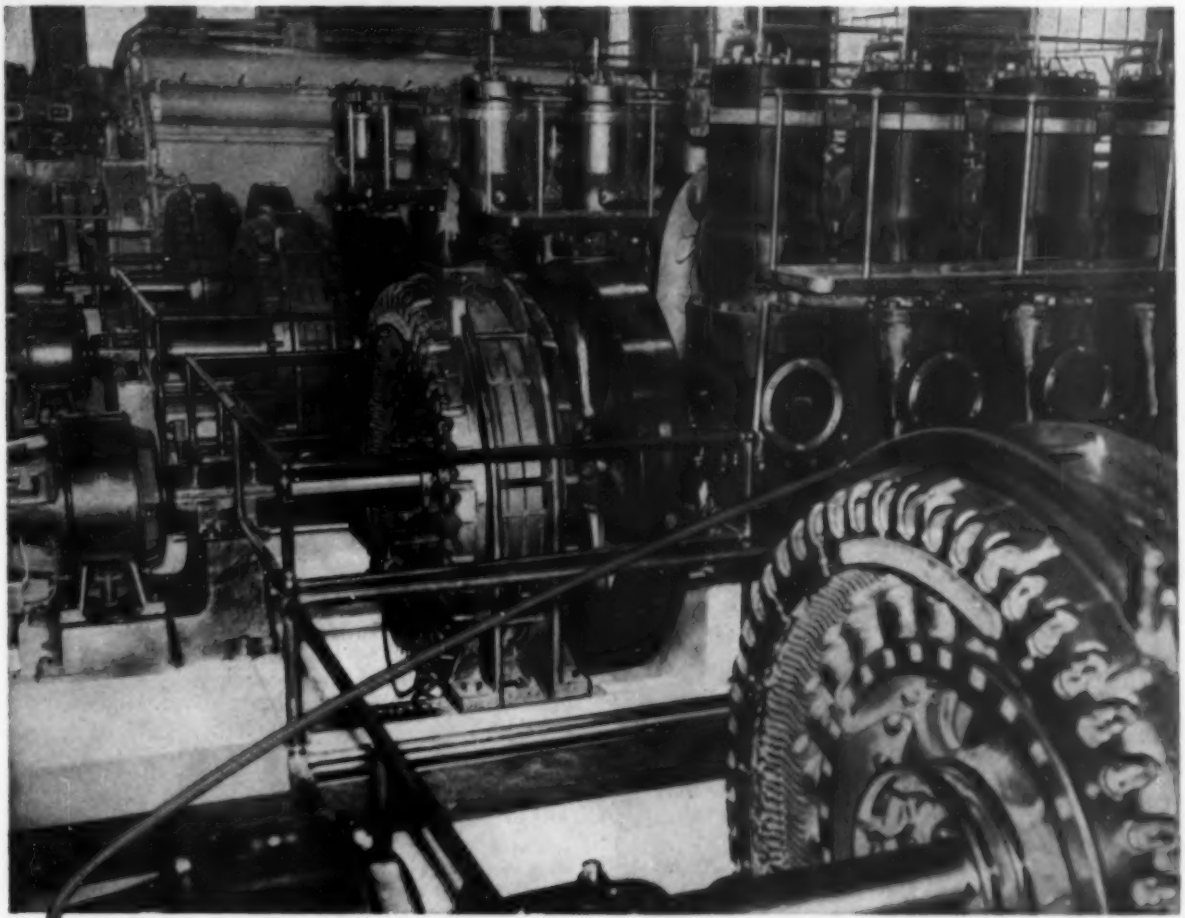
Unusual insulating problem for U. S. Engineers building Thule Air Force Base was that of keeping building heat from reaching the frozen layer of terra firma beneath buildings. This layer of soil or rock has been below freezing temperatures for years. It exists at varying depths, and possesses good compressive strength when frozen. If

building heat thaws the layer, however, the buildings would settle and collapse. To overcome the problem, four-inch blocks of Foamglas cellular-glass insulation were incorporated in floor slabs. Their compressive strength of over seven tons/sq ft allows them to bear the weight of concrete wearing surfaces as well as heavy aircraft and equipment. They are impervious to moisture, so they will not deteriorate under these conditions.

Traveling toolbox speeds maintenance work

Traveling toolbox, devised by Continental Motors Corporation's maintenance department, saves dollars by speeding repair work and cutting downtime on production machinery. Gas-powered Clarkat towing tractor was fitted with racks, cupboards, and drawers behind the driver's seat. Simple frame welded to tractor body holds ladders, extra pipes, and other long items. Vise is bolted

Resists Wear!



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Actual performance results prove that the superior GASCON Oils eliminate stuck piston rings, reduce carbon deposits on vital engine parts, cut cylinder wear to a minimum . . . and improve the ratio of KW-HRS. per GALLON of Lubricating Oil.

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ideas in action

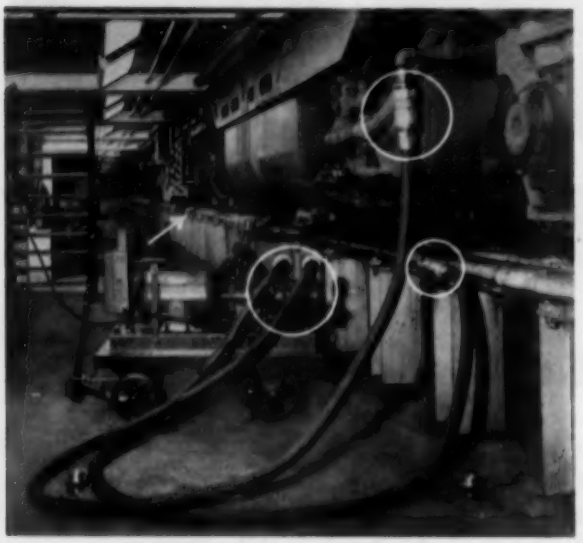
. . . starts on page 66

to worktable on top of cupboard. Headlight on hood serves as spotlight for dark areas. Two men can ride machine. Unit has eliminated two-thirds of travel involved in getting tools to a repair job. Previously, maintenance crew would investigate the job to see what tools were required, then make one or two round trips to tool room to gather all equipment. Now, one call services most jobs.

Hose couplings clean up maintenance shop

Modern lubricant handling system at Pittsburgh & Lake Erie Railroad Company's diesel locomotive servicing shop has almost completely eliminated the usual spillage of oil and grease on shop floors and walls. All drained lubricants are pumped to an outdoor storage tank through a pipe along each rail of the servicing track. Oil is then shipped by tank car to an oil reclaiming plant.

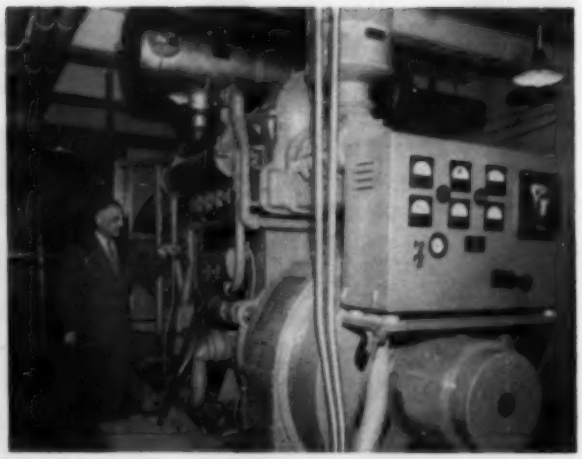
Tracks each hold as many as five diesel units at once, so drain connections have to be flexible. Crankcase out-



let pipes are connected by hoses with Titeflex Quick-Seal couplings to intake line. Couplings are installed at several points along rail. A small portable pump, hooked in right at the locomotive, provides the small pressure needed for positive delivery of lubricant to outdoor storage tanks. Couplings have a built-in check valve that makes system leakproof, yet allows full swiveling with fast connecting and disconnecting action.

Diesels take care of phone bills

New automatic diesel powerplant has been put into service by General Telephone Company of California to insure continuous operation of the system's largest single installation of automatic toll-ticketing equipment. The 300-hp Fairbanks-Morse opposed-piston engine starts and picks up load within six seconds. Failure of ac power could result in complete loss of pulsing for entire office, disruption of telephone service, and loss of all toll billing

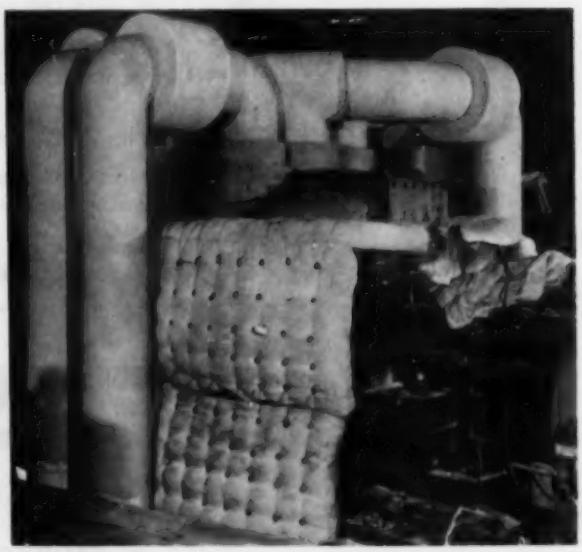


for the period of failure. Power unit and all accessories are installed in a small basement room. Engine and generator are mounted on a steel base but rest on vibration isolators.

Two alternatives were considered for provision of standby power protection. First, doubling storage-battery size to provide a five-busy-hour reserve for increased electrical load; second, a two-busy-hour battery reserve with a diesel generator. Five-hour reserve battery would have cost approximately $78,000, excluding special floors that would have had to be constructed to carry additional weight. Two-hour battery costs about $34,000. The diesel plant was installed for substantially less than the $44,000 difference. Besides, a battery would have lasted a maximum of 15 years, while a heavy-duty standby diesel should serve for 30 years or more.

Turbines get tucked in now

Six-inch thick insulating blankets, laced with Monel wire, are used at Duquesne Light Company's Elrama Power Station to cut down turbine heat loss. Mats weighing 200 pounds are mounted on the outside surfaces to form a protective blanket over the 950 F, 1250-psi units. Blanket seams are laced tight with Monel wire, which is



AIR AT WORK

New two-stage Ro-Flo compressor provides constant efficiency... cuts maintenance

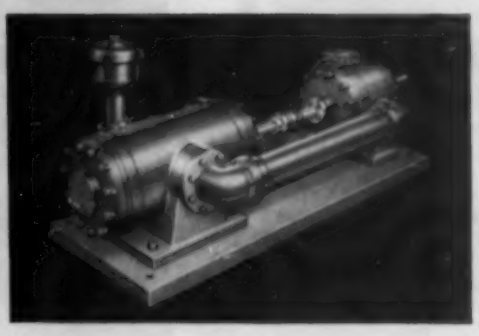
Efficiency and air supply are constant year after year with *Ro-Flo* compressors. Even if wear occurs, it automatically compensates for itself so that air supply is unaffected.

In addition, rotary design eliminates practically all vibration. No heavy foundations are needed.

Maintenance is cut too! There is no wear and tear from shock and vibration . . . no hard-to-maintain pistons and valves.

For constant efficiency . . . overall savings on air, modernize plant air supply with two-stage *Ro-Flo* compressors.

GET THE FACTS: Contact your A-C office or write Allis-Chalmers, Milwaukee 1, Wis.



Two-stage *Ro-Flo* compressors in pressures from 60 to 125 pounds gauge, and volumes from 250 to 1800 cubic feet per minute.

Ro-Flo is an Allis-Chalmers trademark.

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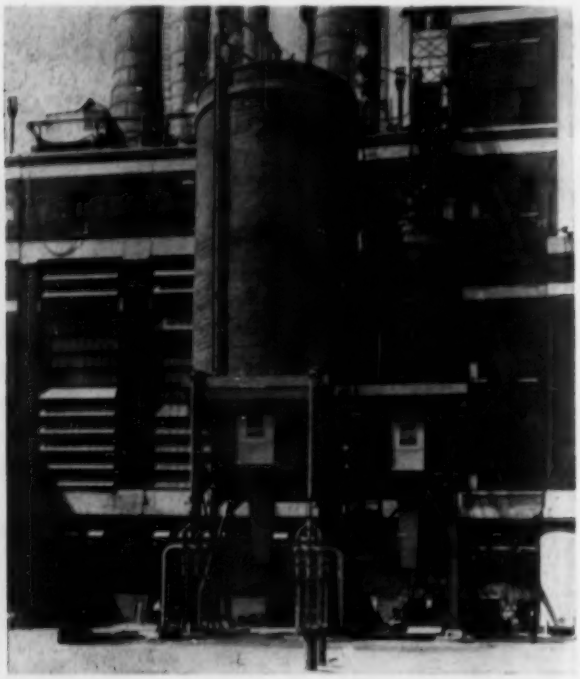
ideas in action

. . . starts on page 66

unaffected by corrosion and vibration. Mats can be removed for periodic inspection by unlacing the wire. After inspection and relacing, unit is quickly and easily wrapped up tight again.

Ford's flyash handling improved

New flyash and bottom-ash handling system has just been installed at Ford Motor Company's Rouge Powerhouse by the Kuljian Corporation. Mechanical dust collectors of aerodynamic-cone design are also being in-



stalled with a pneumatic ash handling system to minimize air pollution from Ford's main powerhouse. Storage silos that will handle 600 tons of flyash and 150 tons of bottom-ash are included in the system. Installation is all part of a revamping program, which includes replacement of two of the eight boilers in this famous powerhouse.

Twenty-four carat air conditioning

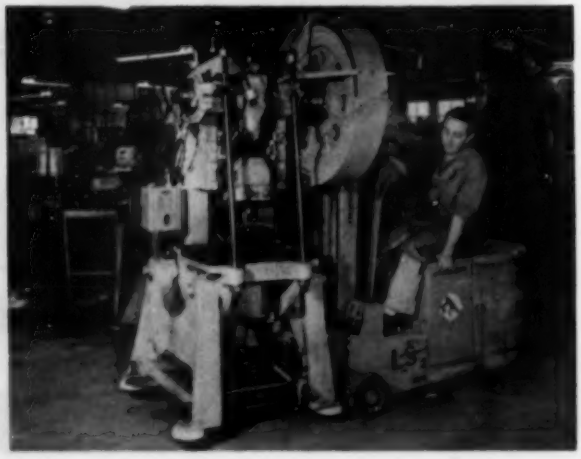
Water-cooled package air conditioning equipment has been installed in the B. F. Hirsch Inc. jewelry plant. Two 15-ton Chrysler Airtemp units have been installed in the ring-making and diamond-setting areas, one 15-ton unit in offices and storage vaults, and a fourth unit in cafeteria. Utmost concentration is required when such materials as gold, platinum, and diamonds are being handled. Since the installation was completed, there has been an obvious improvement in employee performance. Production no longer fluctuates as temperatures go up and down. Removal of excess moisture and dirt from the air aids jewelers considerably in their precision work. Package air conditioners held duct work to a minimum, and offered most economical operation because certain production areas had to have cooling available throughout the year.

Straight-through steam trap simplifies piping

Straight-through inverted-bucket steam traps are saving both installation and maintenance time at Jones & Laughlin's Aliquippa, Pa. Works. One trap drains a main steam line (185 psi at 475 F) to four turbine-driven boiler feed pumps with capacities of 2000 gpm each. New traps, manufactured by the V. D. Anderson Company, require only one nipple and a union for each installation. Maintenance is simplified, too. To check trap, head bolts are loosened and body is slipped off. Piping remains undisturbed while gasket, valve, and seat are inspected.

Pick 'em up, put 'em down

Self-leveling machinery mounts, manufactured by Barry Controls Incorporated, make it possible for industrial plants to obtain much-needed machine mobility. "Leveling Barrymounts" eliminate necessity of bolting or cementing machines to floor. After a machine has finished its production run, it can be picked up and transported to



COPPUS "BLUE RIBBON" VENTILATORS

identified by the blue band

FOR WORKERS'

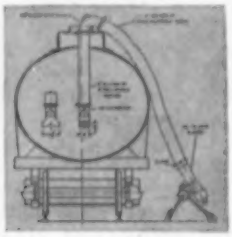
- *Safety*
- *Health*
- *Comfort*
- *Efficiency*

VANO® Design "A" VENTILATOR

Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.

Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.

Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.



Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.

Powered by a ½hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C"

VENTILATOR-EXHAUSTER

Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.

For withdrawing welding fumes from confined places or directly from the welding rod ...or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ...or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a ½ hp motor, it weighs only 85 lbs.

COPPUS ENGINEERING CORP., 151 PARK AVENUE, WORCESTER 2, MASS.
Please send information on the Blowers that clear the air for Action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME.....

COMPANY.....

ADDRESS.....

CITY.....

(Write here any special ventilating problem you may have.)

COPPUS "BLUE RIBBON" PRODUCTS—*Designed for Your Industry, Engineered for You*

Circle 102 on READ-N-CIRCLE card for more data

ideas in action

. . . starts on page 66

a new location, leveled, and be in operation again within fifteen minutes. Formerly, heavy vibrating machinery had to be bolted down to keep it from walking off the job.

Heliport for your plant?

Commercial manufacture of prefabricated heliports — landing areas for helicopters — has just been undertaken by Dravo Corporation. Apparently most heliports will be of the floating-platform type. Although roof tops appear to be the answer to the downtown heliport problem, they are subject to structural limitations of the building. Water-borne landing strips, however, can accommodate weights equivalent to 10,000 pounds per helicopter wheel. Heliports will consist of structurally-supported sections of open steel grating. A deflector-pressure surface below them will absorb downwash from helicopter's rotor or propeller. These floating platforms may be anchored in as little as 30 inches of water. A ramp for approach from shore to flight deck (of sufficient strength to handle ordinary passenger vehicles and mail truck traffic), will be part of the floating equipment. Units come in 10-foot by 40-foot sections, 20 sections making a full-sized heliport. More sections can be added as helicopter size or traffic volume increases.

REPUBLIC
VALVES
INDUSTRIAL • CHEMICAL • AIRCRAFT

J.I.C. AND AN STANDARD TUBE ENDS

Skilfully engineered 2, 3, and 4-way Plug Valves are built by Republic in brass and aluminum alloy, sizes ⅛" to 1". Hydraulic Relief Valves opening at pressures up to 450 psi made in brass, aluminum alloy, steel, and stainless steel, sizes ⅛" to ¾". Pipe, AN or J.I.C. tube ends, or combinations.

4-WAY PLUG VALVE, WITH DRAIN

Also manufacturers of high quality globe, needle, low and hy-pressure check valves, and special valves to specifications.

Write for complete catalog and name of nearest distributor.

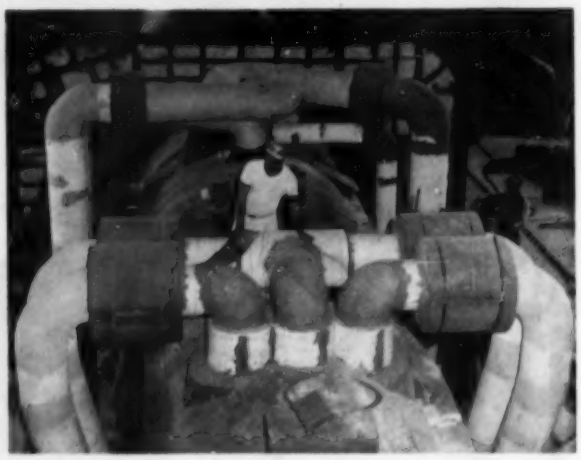
83

RM REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

Circle 149 on READ-N-CIRCLE card for more data

Higher temperature insulation is lightweight

Heat insulation product that withstands temperatures of 1800 F has been developed by Owens-Illinois Glass Co. New hydrous calcium silicate product is used primarily as covering for pipes and vessels. It has unique advantage of slightly expanding up to 1100 F. Completely immersed in a furnace at 1800 F, shrinkage is only about 1½ percent. Kaylo-20 is light in weight (11 lb/cu ft), and has endur-



ing strength (150 lb/sq in. under compression). It is insoluble in water. When dried, it regains its original thermal efficiency and strength without shrinking or warping. Can be easily cut and sawed. Piping insulation is available in thicknesses and diameters for pipe sizes from ½ to 39 inches. Blocks are made 36 inches long in standard widths up to 18 inches, and up to 3 inches thick.

Package boiler saves twenty cents every hour

Package boiler is saving an estimated 20 cents an hour — $1752 a year — for Hudson Hosiery Co. Better production also is being achieved since installation of the 200-hp York-Shipley "Steam-Pak" generator. Unit replaces a stoker-fired coal-burning water-tube boiler. It burns No.

6 fuel oil. The "Steam-Pak" was originally purchased for standby service, but has taken over the primary load and is in operation 24 hours a day, 7 days a week. Besides heating the building, it supplies process steam. Other advantages gained are automatic operation, lower fuel and maintenance costs, and uniform steam pressure.

This new soot blower packing outlasts every type I've tried!
That's J-M CUMPAC 236- it's specially designed to withstand high temperatures and pressures

Now available at your local Johns-Manville Packing Distributor

saves time and trouble . . . reduces expensive soot blower repacking

YOU MAY HAVE ALREADY discovered that traditional soot blower packings cannot withstand the higher temperatures and pressures employed in boiler operation today. Now, Johns-Manville brings you a new packing specially developed for this service. Cumpac 236 won't harden or vulcanize and greatly outlasts all other packings of the conventional types. In plants where it has already been introduced, users report excellent results. Soot blower repacking has been reduced to a substantial degree.

How it is constructed: Cumpac 236 resists high temperatures and pressures because it is specially made of high purity asbestos yarn braided over a plastic core of special heat-resistant composition and lubricated with mica. This material is formed into a combination of lip type and solid packing which provides low friction contact with the soot blower tube and seals the entire stuffing box.

Your J-M Packing Distributor carries No. 236 Cumpac sets for all popular soot blowers. He also stocks other Johns-Manville Packings and Gaskets. Ask him for the Cumpac 236 folder, PK-100A, or write Johns-Manville, Box 60, N. Y. 16, N. Y. In Canada, Port Credit, Ontario.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

Circle 132 on READ-N-CIRCLE card for more data

free bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 83

Air cleaning equipment

500-Improved electrostatic dust control

"Dust and Fume Control," 11-page Bulletin G406, tells of the improvements and refinements that have been made in electrostatic precipitation since the first Cottrell precipitator was erected. Also included are background material and illustrations of the Multiclone mechanical dust collector, the CMP unit—a combination Multiclone and Cottrell unit, the Dualaire dust collector, and the Holo-Flite processor. Western Precipitation Corp.

502-Series on dust and fume collectors

Exhaust fans for dust collecting and air handling are described in Catalog 1002-6. Includes complete performance tables and test curves. Plans and elevations of typical installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities of Norblo bag type, hydraulic type, and centrifugal dust collectors. The Northern Blower Co.

503-Dust collection manual

"The Collection and Recovery of Industrial Dusts," 32-page Manual 101, discusses various types of dust and techniques used in analysis, lists the factors which influence choice of equipment, and explains operation. Buell Engineering Co., Inc.

Air conditioning, heating, ventilating

504-Roof ventilators move 10% more

Dimensions, specifications, and performance data on a complete line of roof ventilators that eliminate back flow of air and increase air delivery by 10 percent are available in Catalog A-112. Includes information and photographs of an efficient low-price roof ventilator and stack cap for simple, economical duct exhaust systems. The Hartzell Propeller Fan Company.

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Boilers and boiler accessories

509-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC, based on total dissolved solids in boiler water. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of the boiler installation. Henszey Co.

510-Water-tube generator specs

Completely packaged Water Tube Type D Superior Steam Generators in 17 sizes, with capacities from 8000 to 40,000 pounds of steam per hour, are described in detail in eight-page Catalog 5M-54. Superior Combustion Industries, Inc.

511-How to survey your steam needs

Formulas behind all package steam generators and illustrations of how a package steam generator installation can raise steam capacity without extensive structural changes are presented in Booklet "Sales Steam 2-1." An example shows how to make a professional survey of your own steam requirements. Complete records and two installation case histories are included. Twelve pages. Cyclotherm Division, National-U.S. Radiator Corporation.

512-Boiler charts and tables

Design data on indoor and outdoor installations of modern high-pressure, high-capacity steam generating units are presented in Bulletin S-55. Also includes charts and tables on the Springfield line of boilers and includes information on superheaters, economizers, air-heaters, steam temperature controls, and steam purifiers. Twelve pages. Springfield Boiler Co.

513-Handbook on startup

Handbook covers washing out new boiler, putting it in operation, handling in service, firing methods, and shutdown. Includes big section of everyday engineering data. Forty-eight pages. Titusville Iron Works Co.

Compressed air supply

515-Packaged heavy-duty compressors

Heavy-duty compressors that are ready to run when received, save installation time and expense, and require smaller foundations and floor space are described in Bulletin L-676-B1. The savings to be made in installation costs and in operation and maintenance costs are discussed. Salient features are described with the aid of four-color drawings and photographs. Thirty-two pages. Worthington Corporation.

Corrosion control

516-Handy protective coating chart

Tables of properties, application techniques, and industrial uses are offered in Catalog 2-55-3M. Twelve pages. Amercoat Corporation.

517-Meet the film-forming amines

"Film Forming Corrosion Inhibitors Also Aid Heat Transfer," four-page Technical Paper No. 129, contains references to protection afforded by filming amines and attendant reduction in maintenance costs secured through protection against corrosion. W. H. & L. D. Betz.

Electrical distribution

518-Outdoor service equipment guide

Designed to make easier the selection of outdoor service equipment, 12-page Bulletin 2016 combines descriptive data on all available standard equipment—service entrance, receptacle type, dual control, three-phase units. Heinemann Electric Co.

519-Correct that low power factor

Booklet 50B, 27 pages, describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. Sprague Electric Co.

521-How to choose circuit breakers

All essential information on the selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections make extensive use of charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Also included are the latest

ENGINEERING

RESEARCH & DEVELOPMENT

There are Qualities *Behind* ANNIN VALVES you'll never find in imitations

QUALITY CONTROL

EXPERIENCE

ANNIN DEVELOPED AND INTRODUCED:

SPLIT BODY

The Annin split-body design has given Industry new standards in control valve construction: lower body pressure loss, greatly reduced erosion, greater rangeability, longer life and reduced maintenance.

DOMOTOR OPERATOR

Out-performs all other pneumatic valve actuators. They are the highest speed, most powerful, and provide the best response characteristics. Long strokes assure that all size valves are truly hi-lift control valves.

TEFLON SEAT SEAL

The teflon seat seal for absolute tight closure, teflon guide bushing to eliminate guide clearance, and teflon V-ring packing for reliable stuffing-box performance were developed and introduced by Annin.

DOOLSEAL

Providing a new high in stuffing-box practice, the Doolseal, originally developed and introduced by Annin, assures reliable seal for hard-to-handle or toxic chemicals without resorting to mechanical seals.

...and many others!

CUT INVENTORY **50%** WITH

ANNIN *Control* VALVES

THE ANNIN COMPANY
6570 East Telegraph Road
Los Angeles 22, California

Circle 145 on READ-N-CIRCLE card for more data

Your plant and equipment suffers . . . your community goodwill fades away. These problems can be solved. Prat-Daniel Collectors are designed for the control of industrial dusts and flyash. Multiple small diameter tubes provide powerful centrifugal forces, resulting in sustained high collection efficiency . . . even with ultra-fine dusts.

Whether the problem is industrial dust or flyash, you are assured of satisfaction with P-D Collector Systems, engineered to meet your specific needs.

Write for Reprint No. 102 titled, "What Type Collector?"

pd

Project Engineers
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GREENWICH, CONN.
(Offices in 38 Principal Cities)
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Designers and Manufacturers
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.
POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

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free bulletins

. . . starts on page 74

prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and eliminate errors. Sixty pages. I-T-E Circuit Breaker Company.

Electrical utilization

523-Automation through speed control

Colored cross-sections and phantomed views show how pneumatic control has been designed into U. S. Varidrive motors to increase and improve production output. Bulletin 1882 shows typical automatic control applications. Eight pages. U. S. Electrical Motors, Inc.

524-High-voltage motor control

High-voltage starters with current-limiting Limitamp fuses offer coordinated control of squirrel-cage, synchronous, wound-rotor, and multispeed motors. Bulletin GEA-6331 shows simplified installation, and reduced space requirements. Twelve pages. General Electric Company.

525-Rugged dc contactors and relays

Heavy-duty dc contactors and control relays for heavy industry applications are described in Bulletin 14B8171A. Available in ratings from 25 to 100 amperes 600 volts maximum, the units feature many interchangeable parts. Illustrated with a color code chart. Eight pages. Allis-Chalmers Manufacturing Company.

526-Control devices guide

Photos, diagrams, and specifications for key switches, impulsing devices, switchboard lamps, and other control devices are given in 28-page Bulletin 4018-D. Automatic Electric Co.

527-Heat with electricity

Industrial electric heating applications and methods are described in 32-page Booklet, "101 Ways to Apply Electric Heat." Illustrated case histories show experience-tested ways to apply metal-sheathed Chromalox electric heating units in industrial jobs. Edwin L. Wiegand Co.

Engines: diesel, gas, steam

528-Heavy-duty diesel engines

Information on the lubrication, cooling, and fuel injection systems of Type S and SS heavy duty diesel engines is presented in Bulletin 10,040. It includes details about engine housing design, full floating aluminum bearings, large diameter crankshaft, gear-driven auxiliaries, specifications, and engineering data. Illustra-

tions of the engine and component parts are included. INGERSOLL-RAND.

529-Diesel rating chart

DR Diesel Engines, as used in municipal power plants, water works, sewage treatment plants, and other industrial applications, are shown in eight-page Bulletin S-500-B52B. Rating chart gives information on 5, 6, 7, and 8 cylinder engines from 550 to 2200 hp. WORTHINGTON CORP.

Fuels and firing equipment

530-Firing equipment selection chart

Package steam generators in sizes 10,000 to 46,000 pounds steam per hour are described in Bulletin PG-55-3. Chart is included with capacities, dimensions, construction features, accessories, sectional drawings, and installation, photographs. Sixteen pages. FOSTER WHEELER CORPORATION.

531-Industrial heating handbook

New handbook provides plant engineers with basic concepts of industrial heat processing and heat control. Pruned of technical language, the handbook goes from a discussion of heat-to-fuel cost comparisons to design elements. Common formulas used in calculating heat and oven requirements are included. Bulletin 555 is a refresher course in process heating, and is a must for all plant engineers. Twenty pages. MICHIGAN OVEN COMPANY.

532-New combustion sampling

The full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in Bulletin 703. The equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. ARNOLD O. BECKMAN CO., INC.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

Heat exchangers

533-Heat exchange equipment specs

This 16-page bulletin gives all pertinent specification data for hot water storage heaters, instantaneous and converter heat exchangers, instantaneous and converter water heaters, and fuel oil heaters. PATTERSON-KELLEY CO., INC.

534-Heat exchanger operation

Air-flow diagram in two-page Data Sheet 124 graphically shows operation of

NEW WAY TO

REDUCE STEAM COSTS

AND INCREASE PRODUCTION

☐ Here is a new steam trap that meets all operating conditions!

The Strong Hydro-Flex Steam Trap performs efficiently under light loads yet gives the same high standard of performance under heavy flow, also greater discharge capacity when needed.

We guarantee your steam system will improve with Hydro-Flex. Outstanding plus-features include: a dual fulcrum arrangement that snaps the valve wide open to give unrestricted condensate flow, all stainless steel working parts including one piece deep-drawn stainless steel bucket. The rugged construction features of Hydro-Flex provide long service life with minimum maintenance.

Your local Strong distributor will give you complete information or write us for Bulletin No. SS-40.

STRONG, CARLISLE & HAMMOND COMPANY
1392 W. 3RD. STREET • CLEVELAND 13, OHIO

STRONG HYDRO-FLEX high efficiency under all condensate loads STEAM TRAPS

HORIZONTAL TYPE SERIES
Hydro-Flex traps with horizontal inlet have the same features as bottom inlet types.

Available from over 200 industrial distributors in the United States, Canada and Foreign Countries.

3 types available for wide range application . . . to meet pressure and capacity requirements.

PRESSURE REGULATING VALVES

are custom sized for job demands. Bolted body permits non-threaded seats and wide selection of seat sizes.

BLOW-DOWN VALVES

STRONG STRAINERS
Offer maximum protection from dirt, scale or sediment. Available in semi steel, cast steel and bronze.

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"After 15 Years the Cushions Were Worn"

... actual report on

LOVEJOY

Flexible Couplings

Up to fifteen years maintenance-free service is not unusual with Lovejoy lubrication-free flexible couplings.

Performance like this is practical proof of these soundly engineered features:

SIMPLE, RUGGED CONSTRUCTION
Fewer parts. No intricate mechanisms. Nothing to lubricate.

LOAD TRANSMITTED BY CUSHION COMPRESSION
No wear on the metal jaws.

DOUBLE-LIFE CUSHIONS
One half of the cushions act as idlers—except on reversible loads. A quick interchange provides a new set of cushions. This can be done without dismantling the coupling.

Illustration at right shows a Lovejoy Type CF flange-mounted coupling. Rated at 160 hp., 800 rpm., this space saver connects drive shaft between diesel power unit and generator.

You can get Lovejoy performance for your application.

Let us know your requirements or request complete-line catalog.

LOVEJOY FLEXIBLE COUPLING CO.

4843 W. LAKE STREET • CHICAGO 44, ILLINOIS

Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.

Circle 136 on READ-N-CIRCLE card

free bulletins

. . . starts on page 74

the Aero Heat Exchanger for water, oil, or compressed air cooling. How the unit saves cooling water, piping, pumping, and equipment costs is explained. NIAGARA BLOWER CO.

Instruments and controls

535-Mercury-less flow meters

Choice of several mercury-less transmitters is offered with these electronic flow meters, described in Bulletin 55-1074-222. They are suitable for measurement of differential pressures, liquid level, fluid, gas, air or steam flow, temperatures, and pressures. Combination of flows or flow and level can be recorded on the same chart. THE HAYS CORPORATION.

538-Liquid-level control data

Bulletin-1 discusses the factors to be considered in selecting a liquid-level control. It includes controls in types and sizes for handling practically any liquid, at any pressure and any temperature. Eight pages. MAGNETROL, INC.

Lubrication

539-Oil seal manual

Quick reference manual covers selection, application, and installation of clipper oil seals. Descriptions cover the latest seal designs, including extruded and molded oil slingers and end face seals. Essential data is in tabular form. Important points are well illustrated. Twenty-eight pages. JOHNS-MANVILLE.

540-Diesel lubrication revised

Written for everyone interested in the lubrication of diesels, "Lubrication of Diesel Engines," has been revised as Technical Bulletin B-1, 48 pages. It discusses diesel principles and design, types of engines in use, operating cycles, accessories and choice of lubricants. SUN OIL CO.

541-Do's and don'ts for bearings

A helpful list of "do's" and "don'ts" to prolong bearing life appears in Bulletin 506. Also included is information on the storage and handling of lubricants. Four pages. NEW YORK AND NEW JERSEY LUBRICANT CO.

Maintenance items

543-How to paint properly

This profusely illustrated Bulletin GET-677F includes a discussion of proper painting methods, preparation of paint, number of coats required, and includes a discussion of repainting subway transformers. Eight pages. GENERAL ELECTRIC COMPANY.

544-Repair leaks with cement

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. SMOOTH-ON MFG. CO.

545-Get up to date on welding

Things you should know about West-Ing-Arc, newest of all MIG welding processes are told in Bulletin B-6525. Physical properties of the welds, cost, and what this process can do for you are discussed. Eight pages. WESTINGHOUSE ELECTRIC CORP.

Materials handling (bulk)

546-Pneumatic vibrators stop clogs

Factual and photographic information on the uses of pneumatic vibrators is included in Catalog 109. Equipment is for use with continuous line pressures from 25 to 100 psig, and on bins containing from one to several hundred tons. Sixteen pages. THE CLEVELAND VIBRATOR COMPANY.

547-Storage capacity tables

Concrete stave storage bins are discussed in this technical brochure. It contains tables of cubic foot weights of flowable materials, capacities, description of wall construction, test data, and other relevant engineering data with many photographs and line drawings. Twenty-nine pages. THE NEFF & FRY CO.

548-Rugged trolley conveyors

Rugged yet simply designed ball bearing trolleys that are engineered to assure rolling contact with the track at all times are described in Bullein 2536. The steel wheels have treads that are machined and hardened for maximum life. Also included are specification and application data and a list of commonly used attachments. Twenty pages. LINK-BELT COMPANY.

549-Conveyor belt slide rule kit

Two slide rules that cut the time required for designing a conveyor belt installation from three hours to ten minutes are now available. They are part of a conveyor belt construction kit. One is a horsepower calculator. The other is a

carcass selector. They incorporate the engineering data contained in a 40-page conveyor belting notebook. UNITED STATES RUBBER COMPANY.

Mechanical power transmission

550-How to select flexible couplings

Complete chart for easy selection of flexible couplings is contained in Bulletin 4100. Dimension drawings are shown with information applicable to more than 90 percent of all vertical or horizontal applications. Twenty-eight pages. THE FALK CORPORATION.

551-Adjustable speed principles

Principles of operation and use of Dynamatic Eddy-Current adjustable speed equipment is described in 16-page Bulletin GB-2. Typical torque and load curves are given. DYNAMATIC DIV., EATON MFG. CORP.

553-New gear manual is a must

Illustrations, diagrams, definitions, tables, charts, and explanations regarding all types of gears are offered in Manual G655. For the first time, a simplified method of calculating horsepower ratings of all types of gearing is presented. This free manual is a must for all plant engineers. Seventy-six pages. PHILADELPHIA GEAR WORKS.

Piping, tubing, and hose

556-Stainless steel weld data card

Engineers interested in the use of stianless tubular products will want this new data card that gives stress rupture properties at high-temperatures of chromium-nickel stainless steel weld deposits. Results of an extensive study. THE BABCOCK & WILCOX COMPANY.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

557-Data on pipe fabrications

Specifications for all sizes of pipe from ⅛ to 24 inches in diameter are presented in 16-page Catalog 575C. Tables give data and descriptions of standard, extra strong, and double extra heavy pipe, spiralweld pipe, large OD pipe, line pipe, electric-weld tubing, welding fittings and flanges, oil well casing, and water well casing. Facilities for fabricating pipe for structural uses also are discussed. L. B. FOSTER CO.

558-How to remove piping deposits

"A Solution to the Problem of Deposits in Piping Systems," four-pages, describes the three principal methods used in cleaning lines: chemical, pipe line pig, and jet moles. Case histories from industry demonstrate where the various methods should be used. DOWELL, INC.

Pumping equipment

559-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON CO.

560-Opposed impeller pump balance

How opposed impellers balance axial thrust is covered in 12-page Brochure 1502. Sizes from 2 to 4 in., with 2 to 8 stages, are presented for capacities to 1000 gpm, pressures to 1200 psig, and temperatures as high as 350 F. DELAVAL STEAM TURBINE CO.

561-How to use package feeders

Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How the feeding unit can be connected to the piping of your plant and to the

Pick INSTANTANEOUS HOT WATER HEATERS
ENGINEERED FOR SERVICE

Industries everywhere are replacing outmoded water heaters with Pick Instantaneous Water Heaters. Here are the reasons:

★ Water Is Heated Instantly. Entirely automatic, Pick Heaters operate by steam injection to heat the water in a flash to exact temperature desired and in volume required.

★ Fuel Savings Are Substantial. Steam injection heating is the most efficient method known. There's no waste because water is heated only as used . . . never stored and allowed to cool.

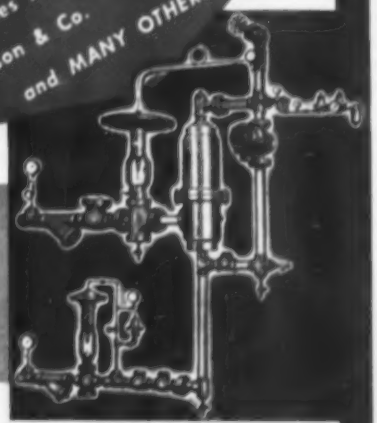
★ No Storage Tanks Required. Compact design of Pick Heaters permits out-of-the-way installation in corners, on walls or overhead. Saves valuable floor space.

★ Exact Temperature Control. Pick heaters can be operated at low or high loads with minimum temperature fluctuation. And it's done quietly.

★ Maintenance Cost Is Low. Pick Heaters can be cleaned in a matter of minutes — worn parts easily replaced.

★ Installation Is Inexpensive. Only ordinary pipe connections are required.

PICK HOT WATER HEATERS . . . Used by
• United States Steel Co.
• Ford Motor Co.
• H. J. Heinz
• Bethlehem Steel Corp.
• Hercules Powder
• Wilson & Co.
and MANY OTHERS



SAVES MONEY FOR ANY INDUSTRY THAT USES HOT WATER!

Write for booklet on how PICK HEATERS cut costs of Hot Water — No Obligation. Write IP-655

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PURIFIES WATER BY REMOVING DISSOLVED SOLIDS

The most *reliable* method of purifying water containing dissolved solids such as calcium carbonate, magnesium sulphate, sodium chloride, silica, or many other common contaminants, is ILLCO-WAY ionXchange (also known as de-ionization). Many adaptations of the basic methods are available including the new mixed-bed de-ionizers which produce water described by one user as of "fantastic purity"

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Illinois Water Treatment Company has pioneered in the design and manufacture of *practical equipment* for ionXchange processes ever since the first year that the de-ionization idea came out of the laboratories. A wealth of experience has been accumulated so that "ILLCO-WAY" is today recognized as the *leader* in the development of *commercially successful installations.*

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With the rapid expansion of the field of nuclear science, various needs have developed for ionXchange, particularly in the purification of wastes contaminated by radioactivity. ILLCO-WAY equipment has been designed and built for this and other purposes in several plants employing atomic energy. *For further information on the uses of ILLCO-WAY ionXchange, write . . .*

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free bulletins

. . . starts on page 74

electrical control equipment is explained. BIRD-ARCHER CO.

Refractories and insulation

562-Refractory concrete manual

"Refractory Concrete Manual," 16 pages, covers basic information on recommended practice for mixing and placing refractory concrete. Lumnite Div., UNIVERSAL ATLAS CEMENT CO.

563-How to select refractory

"Boiler Refractories," 20-page Bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. BABCOCK & WILCOX CO., REFRACTORIES DIV.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 83.

Traps, strainers, and separators

565-Steam trap handbook

Catalog 68G, 31 pages, describes and illustrates complete line of steam traps, strainers, regulating and reducing valves, separators, and vacuum and lifting traps. STRONG, CARLISLE & HAMMOND COMPANY.

566-Stop clogging steam equipment

Prevent rust, scale, and dirt from clogging steam equipment with use of Yarway fine-screen strainers. Bulletin S-204 gives prices, rates, dimensions, and woven screen data. Six pages. YARNALL-WARING CO.

Valves and regulators

568-Simple valve index

Valve users can easily obtain data on valves for a wide variety of applications by using the simplified cross index in 27-page Catalog 105. The most widely used cast and forged steel Edward globe and angle stop, non-return, check, gate, hydraulic, relief, mudline, flow-off, instrument valves, and strainers are included. EDWARD VALVES, INC.

570-Control valve reference book

Three basic types of single-seated diaphragm control valves are discussed in 15-page Bulletin 5304. Cutaway views and charts with complete specification data make this a good reference book. LESLIE CO.

Vibration and noise control

571-Silence with snubbers

Explosion resistant snubbers, known as the BEC, BES, and BEO lines, for commercial, standard, and optimum silencing respectively, are described in eight-page Bulletin 252. Each type is shown in an elevation drawing accompanied by photos of typical installations in industry. BURGESS-MANNING CO.

Water supply and treatment

572-Meet spray-atomizing deaerators

Spray-atomizing type units are shown in cross-section in four-page Booklet 400. Function, design and operation, construction, outstanding features, and uses are discussed. AMERICAN WATER SOFTENER CO.

573-Water treatment explained

"Water Conditioning—One Source for Every Need," 19-page Bulletin 611B, presents the wide range of products available from this company and explains how each type solves particular problems. ELGIN REFINITE DIV., ELGIN SOFTENER CORP.

574-Pocket size water testing kit

Water hardness can now be measured to the nearest 0.2 grain per gallon in an on-the-spot test that takes only one minute. Three-ounce kit consists of a glass vial and a bottle of reagent, is contained in a white plastic box that easily fits the pocket. Complete details of the Zeo-Kit are given in Bulletin 7RE55. CALGON, INC.

576-Recirculation treatment chart

A method for protection of cooling water equipment and recirculating water systems is presented in Bulletin 68. Includes handy check chart to help indicate if your system would benefit from this treatment, and explains how it works. Four pages. NATIONAL ALUMINATE CORP.

577-How to supply your own water

Methods of abstracting water from the ground or by infiltration through permeable beds of rivers or other bodies of water are discussed in 20-page bulletin. Performance charts for this company's collector are supplemented with cross-sectional drawings and cutaways. RANNEY METHOD WATER SUPPLIES, INC.

579-Supplementary water treatment

"No. 40 Series Supplementary Treatments," three-page Booklet 28X8226, discusses supplementary treatments for boiler makeup water such as treatments for softening traces of hardness, dispersives for conditioning of sludge, oxygen scavengers, and anti-foam agents. ALLIS-CHALMERS MANUFACTURING CO.

KEYSTONE STEAM GENERATORS

are RELIABLE *and* ECONOMICAL *to operate*

Here's Why

5 Sq. Ft. of heating surface per developed H. P.

Fully automatic controls

All piping and wiring at the factory

Ease of installation

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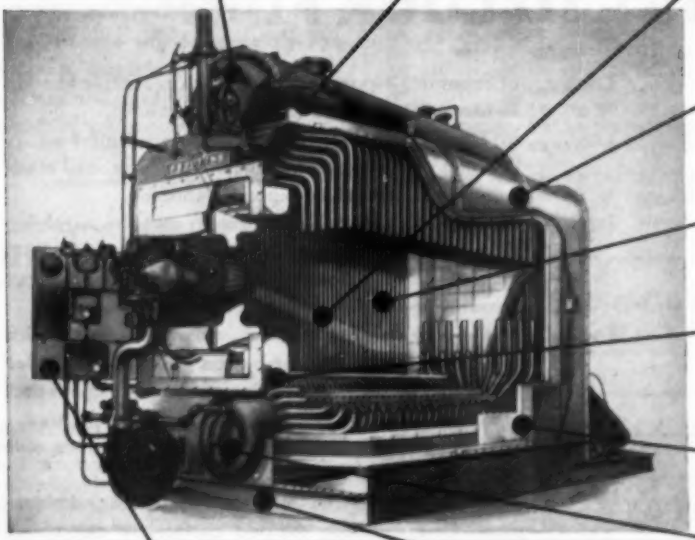
Two-drum boiler—all tubes terminate in drums. No headers, no handholes.

Full length internal steam baffle and outlet steam purifier insure dry steam.

Monolithic refractory gas baffles. No. warping. No leakage.



Removable bolted panel type casing gives access to tube banks.

Tangent tube furnace walls keep heat absorption rate to a desirable low figure.

Windbox and burner fronts are hinged for furnace access and inspection.

Thick block insulation protected by refractory lining; holds heat loss to a minimum.

Panel board is an integral part of the steam generator —all interwired and mounted before shipment.

Entire Keystone is mounted on a rigid structural base extended to form the rear fan platform.

Both drums have large manholes for easy access to internals.

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115 Years in Steam Generation

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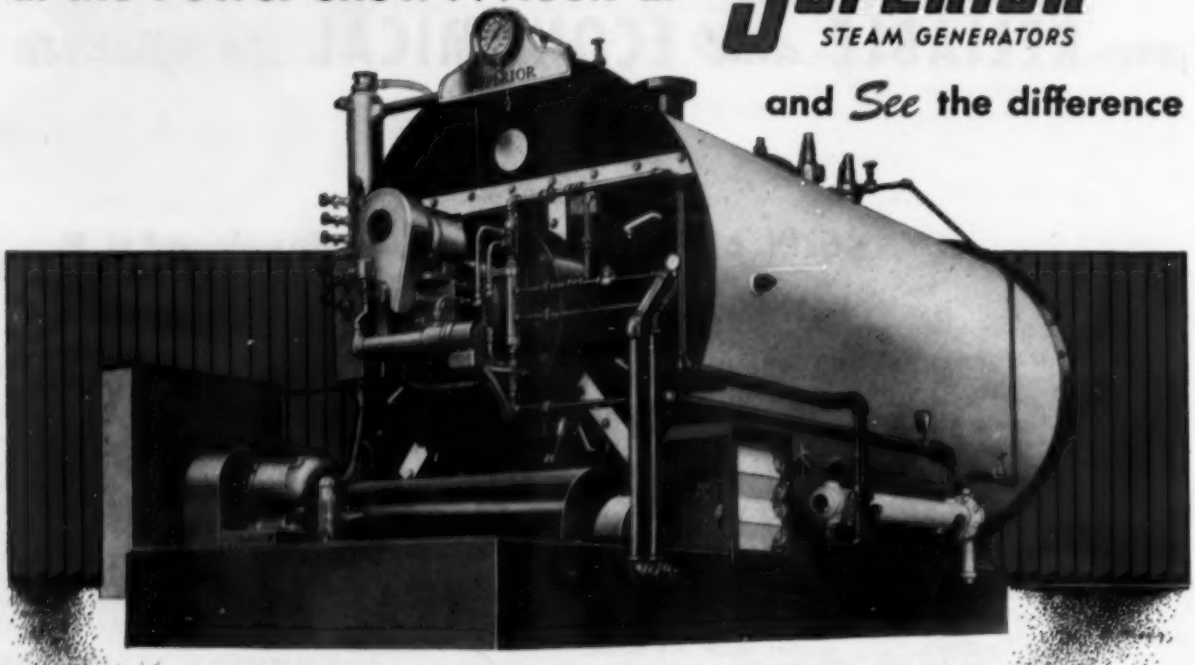
and *See* the difference



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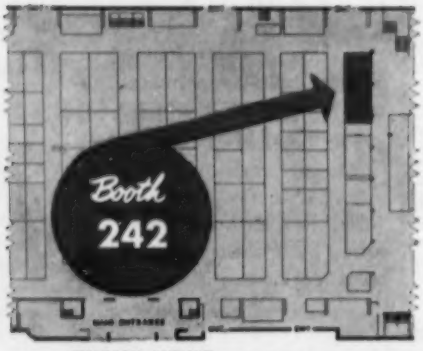

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Look . . . at Superior's built-in multiple induced-draft fans . . . drawing evenly across the entire tube area, and eliminating the need for an expensive chimney.

Look . . . at Superior's Rotary Burner with its own fan supplying primary air . . . fully automatic with oil or gas, or both . . . change from either fuel to the other quickly, without dismantling equipment or interrupting steam supply.

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SUPERIOR COMBUSTION INDUSTRIES INC.
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For reliable, economical steam
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Pumping equipment

Dependability in pumps
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DELAVAL STEAM TURBINE COMPANY. Years of research and design assure positive performance of DeLaval boiler feed pumps. Bulletin 1506 describes and illustrates significant features.

Economical water pumping
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WORTHINGTON CORPORATION, Vertical Turbine Pump Division. More and more industrial plants are turning to Worthington vertical turbine pumps as the most economical means of supplying water.

Refractories and insulation

New refractory handbook
Read page 31 and circle number 140
THE BABCOCK & WILCOX CO., Refractories Division. Here is a digest of refractory information which is a must for every plant. Send for Bulletin R36.

handy guide

. . . starts on page 83

Maintenance follow-through
Read page 13 and circle number 141
THE BIGELOW-LIPTAK CORPORATION. B-L believes in service. Permanent records are kept of every industrial furnace enclosure installed. Rush repairs are handled quickly, efficiently. See your B-L engineer for details.

Traps, strainers, and separators

Increase output—decrease input
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Valve leadership
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LESLIE CO. Floatless Level Control Pilots regulate liquid level to maintain peak output. Saves maintenance, too. Bulletin 5303.

Hold your temperature
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THE POWERS REGULATOR CO. Control that temperature! Durable bellows gives 50 percent more power than majority of regulators. Write for Bulletin 329.

Quality valves
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REPUBLIC MANUFACTURING CO. Complete line of plug, globe, needle, and check valves is available at Republic. Send for catalog.

No reducing valve needed
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SPENCE ENGINEERING COMPANY, INC. For real economy in temperature control, Spence offers a temperature regulator that eliminates need of a reducing valve. For details of design features and engineering, write for Bulletin T50.

Water supply and treatment

Meet Mr. "Betz"
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W. H. & L. D. BETZ. The Betz Sales Engineer is trained to assist you. Let him explain the Betz completely integrated water conditioning service.

Complete water conditioning
Read page 9 and circle number 152
COCHRANE CORPORATION. This complete service provides a single responsibility for continuous satisfactory operation. See Cochrane at the Chicago Power Show, November 14-18, at booth 197.

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Read page 86 and circle number 153
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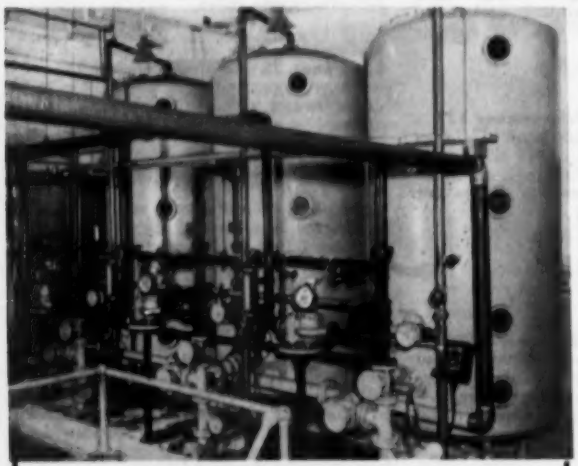
Reliable water purification
Read page 80 and circle number 154
ILLINOIS WATER TREATMENT CO. Fantastic purity is the description given to water purified by the Illco-Way Ion-Xchange. Write for further information.

Economical water supply
Read page 95 and circle number 155
RANNEY METHOD WATER SUPPLIES, INC. Infiltration has proved to be an efficient economical method of collecting huge volumes of pure water. Write for details.



18,000 GPH H&T UN-A-BED DEMINERALIZER PLANT

. . . a typical H&T installation

Since 1943, we've been building demineralizer plants. All sizes, all capacities — manual or automatic available. Highest quality, attractive prices, fully guaranteed. Hundreds of units in service.

Also a complete line of other water conditioning systems. Write for details.

HUNGERFORD & TERRY, INC.
CLAYTON 1, NEW JERSEY

Circle 153 on READ-N-CIRCLE card for more data

next month in
INDUSTRY & POWER . . . .

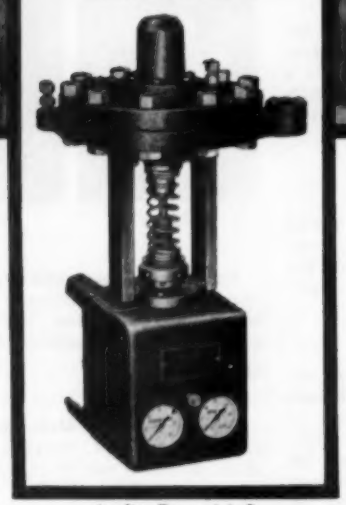
the nature of corrosion in steam plants

Sharpen your perspective on corrosion by reading this article, which offers a comprehensive view of an everyday problem—a problem so recurrent that the daily battles with it often obscure the total picture. For the oldtimer, this article will help put the total subject into total focus. For everyone, this article will help evaluate the total corrosion problem in steam plants. Watch for it in

the December issue of
INDUSTRY & POWER

Here's the *pilot* with the *sense* to save *dollars*

Close Control



Leslie Type LA-2
Level Control Pilot

EXTRACTION TYPE FEEDWATER HEATER DRAIN CONTROL
This Leslie liquid level controller is installed in heater drain service in a Midwest utility station. You will also find Leslie liquid level controllers in condenser hot well service, de-aereating heater installations and boiler level control.

Leslie Floatless Level Control Pilots sense changes in liquid level that will help you maintain peak output. You save maintenance dollars, too — forget troublesome floats and cages (there aren't any).

With low resolution sensitivity (.1 of an inch change in level creates response), you are assured of smooth, throttling action and a closely held level.

There are Leslie Pressure Control and Temperature Pilots with the sense to save dollars in pressure and temperature control stations, too. Your Leslie Engineer, listed under "Valves or Regulators" in your classified directory, will be glad to help you.

Send for Bulletin 5303 on Leslie Control Pilots

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 263 GRANT AVENUE, LYNDHURST, NEW JERSEY

F 5573

CONTROLLED QUALITY MEANS QUALITY CONTROLS

Circle 147 on READ-N-CIRCLE card for more data

names make news

. . . personalities from industry & power

American Society of Mechanical Engineers has designated seven men to become Honorary Members — the highest rank of membership in ASME: **Joseph Bradley Armitage** (vice president in charge of engineering, Kearney & Trecker Corporation); **James H. Doolittle** (vice president, Shell Oil Company); **Samuel Broadus Earle** (Dean of Engineering, Clemson College); **Simes Thurston Hoyt** (Castle & Cooke, Ltd., consulting engineers); **Carl George Arthur Rosen** (Caterpillar Tractor Co.); **Philip Sporn** (president, American Gas & Electric Company); **Clyde Elmer Williams** (president, Battelle Memorial Institute).

Minneapolis-Honeywell Regulator Company has appointed **C. L. Peterson** as vice president and general manager of the Brown Instruments Division.

Exide Industrial Division, The Electric Storage Battery Company, has appointed **Stanley M. Brown** manager of its Philadelphia plant.

Johns-Manville Corporation announces several personnel promotions. **John A. O'Brien** has been named head of the Industrial Products Division. **Don L. Hinmon** will head the new **J-M** Industrial Insulations Division. **Francis J. Wakem** becomes general manager of the Packings and Friction Materials Division. **Robert F. Orth** becomes general manager of the Pipe Division.

Handley

Buttner

Iron Fireman Manufacturing Co. has named **R. K. Handley** as director of manufacturing for all its plants in the United States and Canada.

Le Roi Division of Westinghouse Air Brake Company has selected **H. J. Buttner** as manager of engineering. He holds a Master's Degree from Purdue University where he was a Professor of Automotive Engineering for six years before joining Le Roi.

Copeland Refrigeration Corporation has named **Glennon J. Doyle** vice president in charge of operations. Doyle has been active in the refrigeration industry since 1931.

The Baldwin-Lima-Hamilton Corp. announces executive appointments. **Robert B. Murray, Jr.** former undersecretary of Commerce, is promoted to vice president and member of the board. **James M. White** is now vice president in charge of manufacturing, and **Col. John R. Martin** becomes vice president in charge of Electronics and Instrumentation Operations.

Alco Products, Inc. has named **Douglas B. Fraser** manager of its Cincinnati plant, recently acquired from the Central Pipe Fabricating & Supply Company.

Foster D. Snell Inc. announces new associates. **Miss Muriel E. Warner** joins the staff as consultant for special problems. **Walter A. Bilz, Salvatore J. Graziano,** and **Richard J. Davidson** join the Product Evaluation Department. **Mrs. Adrienne Newhouse** becomes a member of the Food Department.

Jones & Laughlin Steel Corporation announces the retirement of **E. K. (Gene) Miller** after 44 years' service in the steel industry. He will remain active in the industry as a consultant.

Waukesha Tool Company announces the appointment of **Allen W. Salzman** as chief engineer. He is a recognized authority on bearing design and application.

Burroughs Corporation announces reorganization and promotions. **Du Ray Stromback** becomes manager of engineering. **Byron A. Rundo** becomes chief product engineer. **Charles Geisheck** becomes chief product improvement engineer.

Johns

Proctor

Enterprise Engine and Machinery Co. announces the appointment of **Rear Admiral John G. Johns,** USN (Ret.), as manager of its Washington, D. C. engineering office.

Simplex Valve & Meter Company has elected **George N. Proctor,** vice president of the Permutit Company, as a member of the board.

American Viscose Corporation has named **Joseph F. Coffey** to head the newly-created Commercial Development Section.

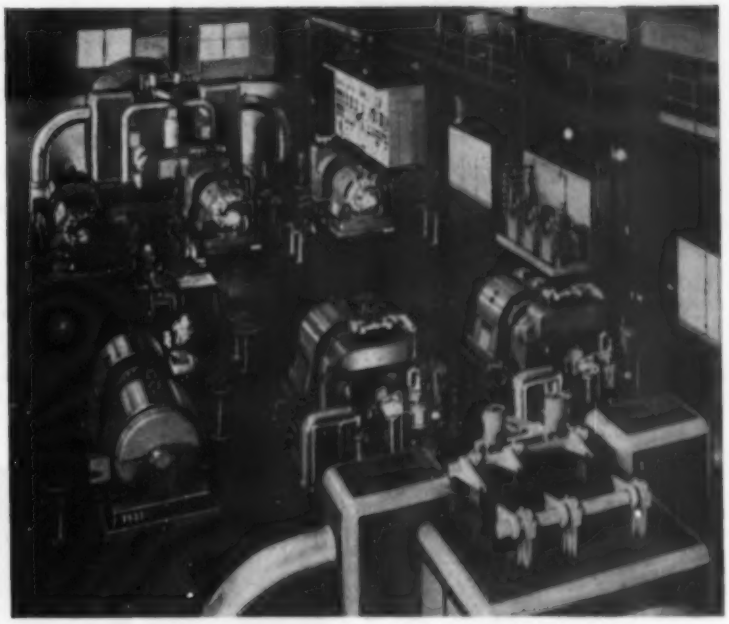
Franklin Institute of the State of Pennsylvania has named **Dr. Claude E. Shannon** recipient of their Stuart Ballantine Medal. This well-known author, mathematician, and inventor is a member of the technical staff of the Bell Telephone Laboratories. The Institute has also awarded the Edward Longstreth Medal

A-4873A

ALLIS-CHALMERS

Circle 111 on READ-N-CIRCLE card

What makes a barrel-type boiler feed pump *stay in service?*



Here are some of the design features that assure dependability

Today's modern multi-stage centrifugal pumps for boiler feed service are the result of years of research and design. To provide efficient service *plus* dependability, De Laval has incorporated these important features in its barrel-type pump.

Double Volute Diaphragms

Double volute diaphragms provide for radial hydraulic balance and assure a continuous rising head characteristic from the design point to shut-off. *RESULT—Higher efficiencies are maintained over a wider range of operation than are generally obtained with other forms of velocity pressure conversion.*

Individual Diaphragm Bolting

Elimination of rabbet fits and gaskets permits straight metal-to-metal contact of adjacent lapped faces of the diaphragms which are individually bolted together to maintain tight joints and ease of assembly. *RESULT—Positive assurance against inner case leakage, complete elimination of misalignment causes and a minimum of distortion from sudden temperature changes.*

Positive Sealing Between Suction and Discharge Chamber

Inner assembly is held at the inner high pressure joint at the suction end of the barrel, against a flexitallic gasket, with through bolts. The joint between the suction and discharge chambers is made tight during assembly—remains tight whether pump is operating or idle. *RESULT—No possibility of leakage or gasket loosening due to changes of force on the inner joint.*

Bare Shaft

Bare shaft construction with split ring-shrink fit method of impeller mounting permits a scalloped shaft design and eliminates the need for spacer sleeves between impellers. *RESULT—Better hydraulic conditions at the eye of the impeller and elimination of spacer sleeves—the greatest cause of shaft warpage.*

Wearing Rings

Diaphragms and impellers have renewable wearing rings. Impeller rings are threaded on the impeller hubs against rotation, and diaphragm rings are held by a breech lock fit in the diaphragms. *RESULT—Construction permits renewal of original clearances without major part renewal or modification. Labyrinth type diaphragm ring results in minimum leakage over a longer period of time than with close clearance flat rings.*

IMO Oil Pump

A De Laval IMO pump designed for high speed operation is direct-connected to the outboard end of the barrel pump shaft, and is sized to lubricate both pump and driver bearings. *RESULT—Quiet, pulsation-free, positive displacement IMO pumps, assures positive lubrication and eliminates the need of extra shaft length and mechanical complications required by gear drive lube oil pumps.*

BULLETIN CONTAINS HELPFUL DATA

This De Laval bulletin on the barrel-type boiler feed pump covers all major design points . . . has cross-section cut-away illustration for easy reference. Write on your business letterhead for your copy of Bulletin 1506 to De Laval Steam Turbine Company, 857 Nottingham Way, Trenton 2, New Jersey.

Circle 138 on READ-N-CIRCLE card for more data

4 EASY STEPS TO BETTER PRODUCTION HEAT

1 Call in

the experienced Chromalox Electric Heating Specialist serving your area. He's as near as your phone.

2 Talk over

your heating plans and problems. You'll be given "case histories" of successful applications similar to your own.

3 Work out

the details of your application with the Chromalox Heating Specialist. Tell him what you want to accomplish in the way of results.

4 Follow Through

on the recommendations. Order the Chromalox Electric Heaters and controls needed for your application. You'll be more than pleased with the time, money and material saving results you'll get with Chromalox Electric Heat!

At Your Service

A STAFF OF EXPERIENCED APPLICATION ENGINEERS

SEND FOR "101 WAYS" HANDBOOK and address of Chromalox Engineer serving you

A-4491

EDWIN L. WIEGAND CO., Industrial Division
7520 Thomas Blvd., Pittsburgh 8, Pa.

☐ Send me 101 Ways to Apply Electric Heat handbook.

☐ Have a Chromalox Heating Specialist call

Name.....

Company.....

Street.....

City.....Zone.....

State.....

CHROMALOX
ELECTRIC HEAT
FOR MODERN INDUSTRY

Circle 118 on READ-N-CIRCLE card

names make news

. . . starts on page 88

to **Richard Y. Case**, assistant manager and chief engineer, United States Rubber Company.

Rockwell Manufacturing Company has appointed **Thomas P. Wall** as general manager of Rockwell Manufacturing Company of Canada, Ltd. He succeeds **W. W. Brydges**, who recently retired from this subsidiary.

Graden

Glover

Goodyear Tire and Rubber Company has selected **J. C. Graden** to manage its technical service and design of Industrial Products. He will be located at the Goodyear-Oxo factory near Mexico City.

Simplex Valve & Meter Company has appointed **Wayne W. Glover** as assistant secretary of the company, in addition to his duties as chief engineer. Glover came to Simplex in June 1924 as blueprint boy, and became chief engineer in July 1942.

Kuhlman Electric Company elected **George R. Fluehr** to the company presidency. **H. E. Greenwalt** was named executive vice president and general manager.

Topp Industries, Inc. has announced the appointment of **Harold D. Roebuck** to the position of comptroller.

Standard Engineers Society has honored **Senator Ralph E. Flanders** of Vermont with an honorary fellowship in SES in recognition of his outstanding contributions in government and industry.

Society of Automotive Engineers, Inc. has nominated **D. Grant Mick'e** as recipient of the 1955 SAE Beecroft Award. He has a national reputation in the traffic engineering field.

Jones & Laughlin Steel Corporation has named **Phillip Hermann** as supervisor of its new Applied Mathematics Section. He has held positions in teaching and consulting work prior to his association with Jones & Laughlin.

Detroit Edison Company announces retirements. **Elmer J. Manuel** retires after nearly 40 years of service with the company. **John A. Lagrou**, assistant treasurer, retires after 48 years of service with the company.

Infico Inc. appointed **John G. Walters** as sales representative for Georgia, North Carolina, and South Carolina. He has served industry for many years as a consultant on waste disposal.

National Bureau of Standards announces the appointment of **Dr. Samuel Zerfoss** as chief of the Refractories Section following the retirement of **R. A. Heindl.** Dr. Zerfoss is a well-known authority in the field of ceramics and refractories.

Westinghouse Electric Corporation has named **Romus Soucek** as manager of defense products for the West Coast.

Campbell

Williams

Acheson Colloids Company has appointed **Erwin J. Campbell** as supervisor of Process Research, Research and Development Department.

Cooper-Bessemer Corporation has elected **Lawrence F. Williams** president. **James E. Brown** was elected to serve as secretary of the company.

General Electric Company promotes **Howard D. Kurt** to product planning specialist, and **Alton J. O'Neil** to marketing research specialist—both for the Distribution Assemblies Department. **Robert W. Sullivan** is appointed senior metals processing engineer.

coming events

. . . for industry & power

Nov. 13-18	ASME Annual Meeting	Congress Hotel Chicago
Nov. 14-17	Second International Automation Exposition and Exhibition	Navy Pier Chicago
Nov. 14-18	Exposition of Power and Mechanical Engineering	Coliseum Chicago
Nov. 27-30	American Institute of Chemical Engineers Regular Annual Meeting	Statler Hotel Detroit
Nov. 28-Dec. 1	Air Conditioning and Refrigeration Exposition.	Auditorium Atlantic City
Dec. 12-17	AIChE Nuclear Congress & Atomic Exposition	Municipal Auditorium Cleveland
	1956	
Jan. 30-Feb. 3	AIEE Winter General Meeting	Hotel Statler New York
Mar. 18-21	ASME Spring Meeting	Multnomah Hotel Portland
Mar. 26-27	ASME Instruments and Regulators Conference	Princeton Univ. Princeton, N. J.
Apr. 1-5	ASME Oil, Gas, and Power Conference	Jung Hotel New Orleans
Apr. 2-4	AIEE Southwest District Meeting	Dallas

next month in INDUSTRY & POWER . . . .

new era coming in fluorescent lighting

High-frequency power for fluorescent lighting promises more steady illumination, lighter-weight components, more lumen output per lamp, and lower overall cost. Read about the installation already completed that is proving the merit of high-frequency fluorescent lighting for the large indoor expanses typical of industrial plants. All the details will be told by the engineers who are pioneering this new era.

watch for the December issue of INDUSTRY & POWER

Same formula as famous Kroil that has pleased 14,000 industrial users for 10 years or more. Loosens stuck together metal parts, bushings, bearings, bolts, screws, pipe, etc., "anything from an embalmer's needle to a bulldozer," one customer said.

"Like an extra employee," said another. "Turned rust into mush, put $50,000 equipment back to work."

You too can get these results.

Try Aerokroil at our risk. Send $2 cash, and we'll pay postage.

KANO LABS. 1085 S. Thompson Lane Nashville 11, Tenn.

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STEAMLINED! to heat water fast, at low cost

In the Johnson Heater, water to be heated is routed first inside, then outside, a blanket of live steam. It's full pressure steam, too; up to 150 lbs., or 250 lbs. in heavy duty types, no reducers are needed. The result: faster, more efficient heat transfer for a unit of its size. No wonder industry has found so many applications for the Johnson "Instant" Heater, in heating water and process liquids of various types.

Sizes for all needs; write for literature

The Johnson Corporation
807 Wood St., Three Rivers, Mich.

Circle 143 on READ-N-CIRCLE card for more data

spot news

. . . about industry & power

• New concept for engineering

The Manhattan District project of World War II developed a concept that will shortly sweep through all engineering in all industry, according to R. S. Stevenson, president of Allis-Chalmers Manufacturing Co. He pointed out, "For the first time in the history of the world, on such a massive scale, we went into mass production before the prototype had ever been built. Our scientists and engineers were sure, two billion dollars were appropriated, and they proved they were right.

"This gives the engineers and scientists following behind them a whole new area in which to work. It means that we can apply sound calculations and expert laboratory techniques to shortcut some of our old methods, which we called testing but which were nothing but trial and error.

"This concept is now being applied to almost every phase of atomic energy development—full-scale atomic energy power plants are now being designed and will be built without a prototype or pilot plant ever having been in operation. . . . It is my conviction that it will shortly sweep through all engineering in all industry."

• Solar power on the way

Solar power may be closer than you think—at least 1000 scientists, engineers, educators, and industrialists are sufficiently conscious of its future to attend the World Symposium on Applied Solar Energy now being held in Phoenix and Tucson, Arizona. Professor V. A. Baum, the first Russian physical scientist to visit this country since World War II, is expected to be among more than 80 foreign scientists who will participate—all of them major contributors in the field.

• Lubrication gets recognition

Council of the ASME approved the application of "Lubrication Activity" for division status at its September meeting. The new Lubrication Division will start to function at the annual meeting of the Society, November 13 to 18. Dr. D. F. Wilcock, of the General Electric Company, becomes chairman of the new division's Executive Committee. Division's objectives are to promote the art and science of mechanical engineering in lubrication, to foster research and development, to publish reliable data pertaining to lubrication, and to encourage the interchange of ideas among engineers and technologists.

• Fuel efficiency growth — what of the future?

As every engineer knows, it has been taking less fuel year after year to produce a given amount of electricity or energy in other forms. Efficiency increase in boilers, generators, and electric transmission facilities has been phenomenal. The electric utility industry has shown a rise of 4.3 percent so far this year compared to last. N. B. Guyol, noted economist connected with the United Nations staff, has observed that the rate of growth of commercial sources of energy has been 3.25 percent per year since 1860. He stated, however, that this production curve naturally understates the rise in requirements—particularly during recent years—because of the efficiency factor. He forecasts that the future growth of energy requirements (excepting war or depression) will take place at a rate of between four and six percent per year. Since the efficiency of fuel use is likely to increase as well, an annual growth in fuel production of 3.5 percent per year will be required.

• Industry grows and grows

In the 12 months ended July 31, the electric utilities increased their installed capacity by 11.8 million kw, or 12.2 percent—bringing the total to 108.8 million kw. . . . The chemical industry will record a 20-percent increase in volume for 1955 as compared to last year. . . . Looking ahead, steel company executives expect that from three to four million tons of new capacity will be added each year, mainly through modernizing and expanding existing plants. . . . Automobile production may reach 7.2 million units this year as against factory sales of 5.6 million units last year. . . . (All these figures have been released through Appalachian Coals, Inc.)

• New materials for industry

A patent application has been filed by US Steel on a new grade of stainless steel that contains little or no nickel. Studies, aimed at conserving nickel, showed that by the proper adjustment of the chemical composition of steels—particularly with regard to chromium and manganese contents—sound ingots can be made with a nitrogen content of more than double the old limit. This discovery opened the door to an entirely unexplored area for a reduction in the use of nickel. A new grade of austenitic stainless steel has been developed with special fields of application. . . . Aluminum Company of America is the first major aluminum producer to offer a complete line of sparkling, color-anodized aluminum sheet, tube, extruded shapes, and fasteners. . . . National Tube Division of US Steel has introduced polyvinyl chloride plastic pipe for nationwide distribution. PVC is known as the "stainless" of plastics. The pipe is lightweight (20 feet of 2-inch standard PVC pipe weighs less than 13 pounds). It has excellent chemical resistance to attack by acids, alkalies, alcohols, and most chemicals.

• Industry defense course

The first Federal Civil Defense Administration Staff College Course for Industry Defense is scheduled to be given at the Federal Civil Defense Headquarters, Battle Creek, Michigan, beginning November 28. The five-day course will include general orientation in all aspects of

Civil Defense planning, organization and operation with special detailed instruction in methods and techniques of preparing for self-help in industrial plants and other large facilities. All parts of the Government-wide Industry Civil Defense Program will be presented. The course is designed to meet the needs of defense coordinators and protection personnel in industrial plants, industrial safety directors, government contractors, emergency and disaster coordinators, state and city industry defense coordinators, and others who have the responsibility for directing industry defense programs and conducting Civil Defense training in plants and other large facilities.

• Separate ratings for your breakers

New, separate, 480-volt ac interrupting ratings for General Electric molded-case circuit breakers have been announced by the company. For F, J, K, and L frame sizes, the new 480-volt ac interrupting ratings are 15,000 amperes, 20,000 amperes, 25,000 amperes, and 35,000 amperes respectively. Until now, the only 480-volt ac interrupting ratings available for these circuit breakers have been the same as those published for 600 volts. Since approximately 90 percent of industrial applications for molded-case circuit breakers are on circuits of 480 volts and below, the new 480-volt ac interrupting ratings make possible substantial savings for panelboard and switchboard users.

• New power station will burn fluid coke

Fluid coke will fuel the three boilers at the Delaware Power and Light Company's 50,000-kw steam generating and electric power station just south of Wilmington. Each boiler will be capable of producing 500,000 pounds of steam per hour at 1250 psi and 950 F. The new power station is being built to meet the needs of the 130,000-barrel-per-day refinery which Tide Water Associated Oil Company is building on an adjacent 4500-acre site. Fluid coke will be produced by the refinery's 42,000-barrel-per-day fluid coking unit.

• More new plants opening

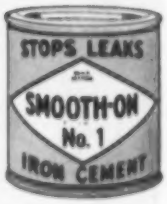
O. C. Keckley Company has just moved into a new plant at Skokie, Illinois, which combines general offices and manufacturing facilities for steam and liquid control equipment. . . . Mycalex Corporation of America has just started production in a new plant at Caldwell Township, New Jersey. This is the first plant ever designed solely for the production of synthetic mica. . . . Westinghouse Electric Corporation's huge new watthour meter plant in Raleigh, North Carolina has been officially dedicated. When full production is reached, it is expected that about 2500 people will be employed. The plant houses over 500,000 square feet of manufacturing space under a 13-acre roof. Two-thirds of the building is air conditioned.

• Companies continue combining

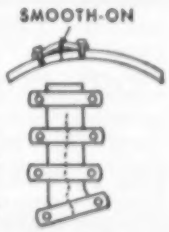
Electro Refractories & Abrasives Corp. has purchased a large interest in Spar-Mica Corp. of Montreal, Canada as a diversification move into the field of ceramic and other nonmetallic minerals. . . . Barry Controls Incorporated has acquired the Insco Company, manufacturers of electro-mechanical instruments and controls. . . . U. S. Industries, Inc. has acquired the assets of Garrett Oil

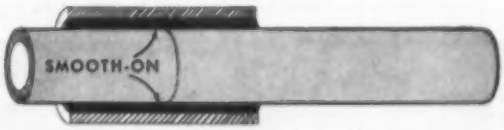
QUICK, LOW COST EMERGENCY Repairs

When you just *have* to get a boiler, or machine or plumbing system back in working condition fast, Smooth-On Iron Cement saves the day . . . and saves you many dollars, too. It makes the repair quickly. Tides you over until the permanent job can be done.



Reinforced Crack Repairs in boilers, water tanks, etc., can be made with Smooth-On No. 1 Iron Cement, as shown. Smooth-On is forced into the crack and a patch plate is then applied over the area with straps held in place by machine screws. As Smooth-On hardens it expands against the patch, making a tight, durable seal.





Emergency Pipe Joint. The same expansion principle applies here. Put the pipe ends into a section sawed from a larger pipe and pack tightly with Smooth-On.

Broken Parts. A broken casting can be repaired temporarily, as illustrated. You make a Smooth-On "sandwich" by bolting on a patch plate at top and bottom.

These are just a few of the many emergency repairs possible with Smooth-On. Better keep a can on hand! Others are described in the *free* Smooth-On Repair Handbook. Ask your supply house for a copy or write us.

SO 419

SMOOTH-ON MANUFACTURING COMPANY

Dept. 19, 570 Communipaw Avenue, Jersey City 4, N. J.

SMOOTH-ON

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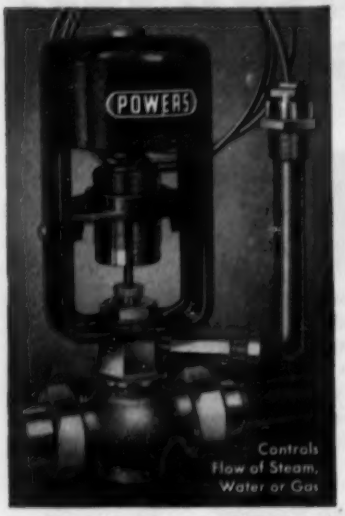
Hold That TEMPERATURE



at the *Right* point with a

POWERS
No. 11
Self-Operating
REGULATOR

Simplest, Reliable Control made for water heaters, industrial processes, heat exchangers, air compressors.

BETTER CONTROL FEATURES

Powers bellows has 50% more power than used in majority of regulators. Durable 2-ply bellows outlast ordinary single-ply type. Valve stem lubricator with silicone grease aids easy movement of highly polished stainless steel valve stem and reduces drying out of packing. Better control results from Powers powerful bellows and minimum of valve stem friction. *Write for Bulletin 329.* (ess)

THE POWERS REGULATOR CO.
Skokie, Ill., • Offices in 60 Cities • See Your Phone Book

Over 60 Years of Automatic Temperature and Humidity Control

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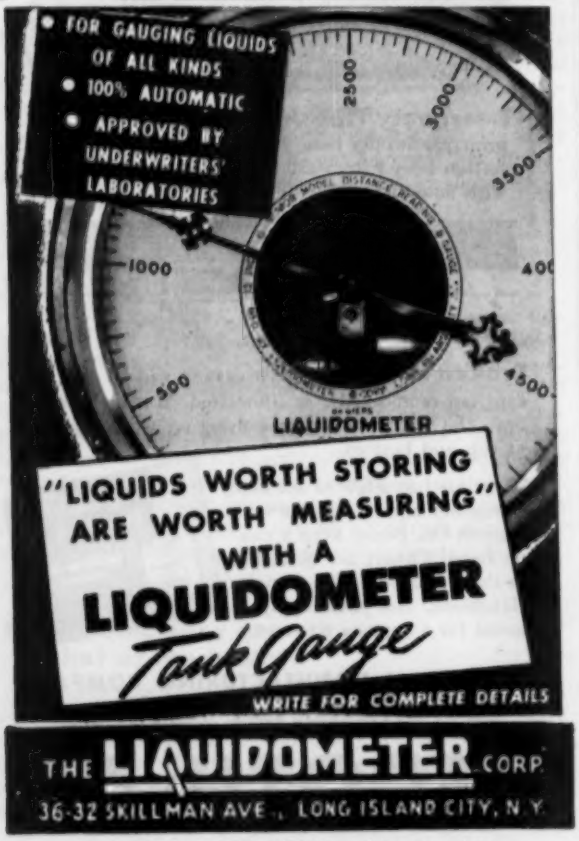

THE LIQUIDOMETER CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

Circle 105 on READ-N-CIRCLE card for more data

spot news

. . . starts on page 92

Tools, Inc. . . . Koppers Company, Inc. has purchased all assets of Turner & Haws Engineering Co., Inc., makers of filters for cleaning industrial air or gas. . . . Ladish Co. has purchased two adjacent Los Angeles plants, CBS Steel and Forge Co. and General Pacific Corp. The plants will operate as the Ladish Pacific Division, Ladish Co.

• New outdoor insulation uses organic materials

General Electric's Instrument Department has discovered a way to fortify organic compounds against high-voltage electrical discharges—a long-sought goal in the search for better insulation materials. HY-BUTE/60 incorporates a chemical mechanism, built into a butyl rubber, which prevents the formation of free carbon. This in turn prevents formation of a carbon track and the consequent failure that occurs if organic components of the insulation break down. Use of the insulation on such items as instrument transformers eliminates oil-filled metal casings, porcelain bushings, and gaskets. This virtually eliminates maintenance and susceptibility to mechanical damage. The insulation has proved superior to porcelain under severe test conditions. Experiments indicate the process is equally effective with phenolics, resins, and other materials now used in electrical apparatus.

• Giant circuit breakers use less oil

Fifteen 330-kv, 25-million-kva power circuit breakers are now installed at the Kyger Creek Plant of the Ohio Valley Electric Corporation. The giant breakers were built by Westinghouse Electric Corporation. All have the "watch-case" design that requires only about 50 percent of the oil volume of a cylindrical tank with the same electrical clearances. Breakers have a continuous current rating of 1600 amperes, will interrupt in 3 cycles, and reclose in 15. They are approximately 28 feet high from foundation to bushing tip, 9 feet wide, and weigh 183,000 pounds when filled with oil. The plant is one of two new generating stations built to supply power to the new AEC installations near Portsmouth, Ohio.

• More plant expansions on the way

National Gypsum Company is building a new manufacturing plant in Burlington, New Jersey for production of wall-board, lath, sheathing, plaster, and land plaster. . . . General Electric Company will build a $5 million plant at Lynchburg, Virginia as a new home for the company's Rectifier Department. . . . Union Metal Manufacturing Co. has already started on a $1 million expansion program involving buildings and equipment for the manufacture of steel tubes and aluminum pole products. . . . Owens-Corning Fiberglas Corporation is going to build a new plant chiefly for manufacture of Fiberglas insulations, noise control products, and other building materials. New plant will be built on a 120-acre site on the New Jersey Turnpike, just southeast of Camden.

good books

. . . for industry & power

Readers wanting to obtain copies of these books may order through INDUSTRY & POWER. *Send check covering cost and we will forward your orders to the publishers.*

Principles & Practice of Electrical Engineering, Seventh Edition, by Alexander Gray; revised by G. A. Wallace; McGraw-Hill Book Company; 598 pages; $12.50.

Here is a book that is ideal for engineers who specialize in other fields, but who need a basic knowledge of electrical engineering. It will also be useful to electrical engineers who want to brush up on basic material.

Subject matter includes a brief review of basic electrical physics, descriptions and explanations of the operation of electrical equipment, and a section on thermionic tubes and photoelectric cells. All in all, the book is quite comprehensive when considered as a text.

The typography is attractive and illustrations are both modern and clear. There are no advanced mathematics here — just a sound refresher course that will not make itself a chore.

Diesel Engineering Handbook, Ninth Edition, edited by A. B. Newell; Diesel Publications, Inc.; 798 pages; $8.50.

This is a comprehensive and fairly up-to-date work on diesel engine design, maintenance, and operation. It could well serve as a basic reference guide for the beginner or expert, but each chapter covers too many subjects for the book to be regarded as the last word.

Some 900 diesel topics are covered including fuel injection systems, cooling systems, fuel oil, frame and cylinder maintenance, pistons and rings, crankshafts and bearings, valves, valve gearing and cylinder heads, supercharging, lubrication, and starting systems. Data on over 1100 makes and models are included in a well-organized table.

The book is well bound and has modern typography. This reviewer, at least, would have been better pleased if several of the illustrative diagrams had been larger. On the other hand, the photographs are good. This should prove to be a worthwhile reference book for anyone interested in diesel engineering.

Techniques of Plant Maintenance and Engineering, 1955; 1955 Plant Maintenance Show, Inc.; 218 pages; $7.50.

This volume comprises the proceedings of the technical sessions held concurrently with the Sixth National Plant Maintenance and Engineering Show in Chicago last January. It contains transcripts of papers, discussions, and roundtable sessions. Among the topics covered are the relationship of maintenance to management, control and organization of maintenance, work measurements and standards for maintenance, planning and scheduling, and managing the maintenance organization. This book is the next best thing to attending the sessions themselves. Between the covers of this book is a wealth of experience reported from many plants, experience that should be valuable to anyone with responsibilities in the maintenance of industrial plants.

Dipping our fingers in the Ohio!

208.8 MILLION GALLONS PER DAY

Here is more proof that the RANNEY METHOD is the most effective, economical means of collecting huge volumes of naturally filtered, non-turbid water.

43 collectors, representing 9 chemical plants, 2 distilleries, 2 Ordnance Plants, 1 Steel Company, and 3 Municipal Water Supplies, are now producing an abundant water supply by infiltration. Results here, as in so many areas, are highly satisfactory.

Take advantage of this low-cost insurance against water shortage problems, without the expense of filter plants and treatment stations.

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Non-Fluid Oil Keeps Pressure Systems Open!

NON-FLUID OIL is outstanding for pressure systems because it will *not* choke up lubrication. NON-FLUID OIL contains no residual matter to clog fittings, it does *not* dry out like ordinary greases, and will not separate under pressure. Lubricates dependably until entirely used up. Keeps down maintenance cost.

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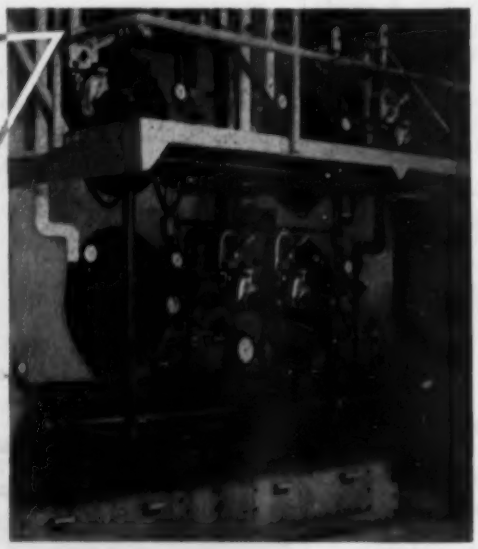

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THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.

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new products

. . . starts on page 10

with this heater than with conventional straight-tube heaters because the two elements are mounted parallel. Made in standard voltages and wattages. GLO-QUARTZ ELECTRIC HEATER CO., INC.

713-Sandblast inside pipes, too

Sandblasting tool for cleaning pipe and tube both inside and outside uses whirling sand or other abrasive substance under great pressure. Tool is passed through

the pipe and does not need to be rotated. Available in four sizes for cleaning ½-through 12-inch pipe. J. C. FENNELLY CO.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 83.

714-Quick setting aluminum putty

Aluminum putty is as easy to use as modeling clay and will not run or sag. It consists of about 80 percent aluminum and 20 percent plastic. Devcon F has excellent adherence to aluminum, steel,

bronze, brass, and cast iron. Bonds to a flat surface and can be machined to a feather edge. After two hours hardening (or a few minutes if heat is used), it can be drilled, tapped, or machined. Once hardened, it will withstand sledge ham-

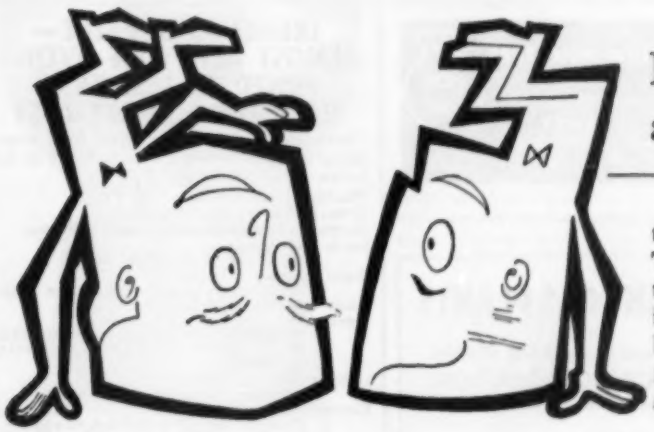
(more new products on page 99)

Our coal bills are lower than they used to be. Are we getting cheaper coal?

No. The coal may be higher priced, but it just costs less.

Man, you've gone crazy! Telling me high-priced coal costs less.

That's exactly what I mean. This coal has less moisture and less ash. That leaves more usable coal in every ton. It burns better in our type of boiler. Add it up, and we're getting the same amount of steam with a lot less coal.



How did you find out about this coal?

I asked the Chesapeake and Ohio coal people to recommend a coal that would give less smoke. The coal they suggested not only burns practically smokelessly, but as you see for yourself, it costs less. I used to buy coal strictly on price, but I know better now. Picking the right coal for any particular set of conditions is a job for an expert.

P.S.

There's a lot more to buying coal than the cost per ton. Why not contact coal producers on the C&O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

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Reprints of Special Reports and feature articles that have appeared in INDUSTRY & POWER can be ordered from Reader Service Department, INDUSTRY & POWER, Commercial Bank Building, St. Joseph, Michigan.

Feature article reprints

Reprints of the following articles are available on single copy orders free of charge:

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- *Vibration Is Tamed So Simply*
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- *Why High Temperature Water?*
- *Will It Pay to Incinerate Your Waste?*
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Individual copies of Special Report Reprints will be sent free upon request. Additional copies are priced as follows: 2 to 24 copies are 25¢ each; 25 to 49 copies are 20¢ each; 50 to 99 copies are 15¢ each; more than 99 copies are 10¢ each. Special Report Reprints available are:

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- *Combating Corrosion From Industrial Chemicals*
- *Contaminants in the Air*
- *Control Valves and Positioners*
- *Demineralization—A Means to Purer Water*
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- *The Packaged Boiler Picture*
- *A Thermodynamics Refresher (Parts I through VI)*

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designed - installed
H. Emerson Thomas & Associates, Inc.

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"Despatch Tower" (75 ft. high) Core oven, Serial #21548, Complete, Dismantled, with the following specifications:

Maximum temperature—500°F.
Average baking time—4 hours
Output—Approximately 5 racks per hour
Rack dimensions—
36" x 102" x 26" high, overall
Total number of racks—
27 (20 racks in the oven at one time)
Rack capacity—400 lbs.
Heater—
"Despatch" direct gas, 1,500,000 BTU per hour (Heater is externally mounted)
Combustion equipment—
"Eclipse" atmospheric type
Electric current specs:
Motors—440/220 v. 3 phase 60 cycle
Controls—110 v. 1 phase 60 cycle A.C.
Fuel—Natural gas, 6" - 8" W. C.

THIS OVEN IS LIKE NEW—IN USE ONLY THREE YEARS

A complete set of drawings, including one assembly drawing and twenty-eight related drawings, is available upon request.

Price—A Bargain at $20,000.00

For further information, please contact Mr. Don Kelker, Purchasing Agent or Mr. Don Smith, Plant Engineer.

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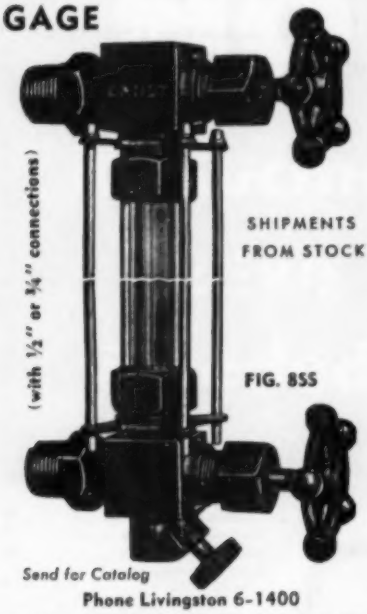
STAINLESS STEEL
GAGE



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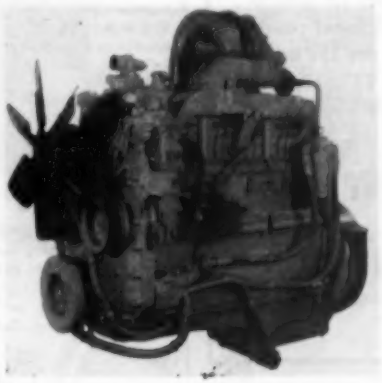
new products

. . . starts on page 10

mer blows. After sandblasting, repairs become invisible. Storage life is unlimited. CHEMICAL DEVELOPMENT CORPORATION.

715-More diesel horsepower per pound

Two new turbocharged diesel engines, rated at 250 and 262 hp with maximum speed of 2100 rpm, operate on all commercial diesel fuel weights. These six-cylinder, four-cycle engines have a piston displacement of 743 cubic inches.



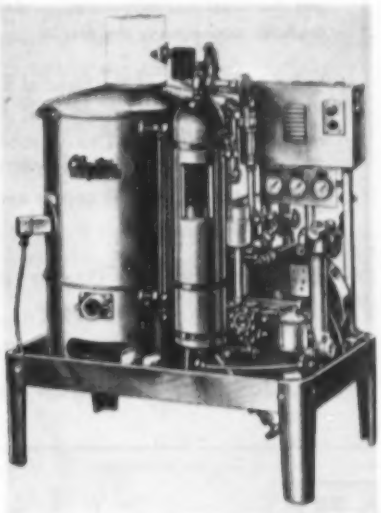
Turbochargers are available mounted either on the side or top. Turbocharger does not absorb developed power, as do gear- or belt-driven blowers. It gives greater efficiency and more horsepower per pound weight of engine. CUMMINS ENGINE COMPANY.

716-How to flood dies with cutting oil

Problem of how to flood dies with cutting oil while threading pipe with die stocks (manual or power-driven) is solved by the Ridgoilr. This portable unit consists of a removable chip pan in an oil reservoir with carrying bail. Screened hose connects with a hand-operated oil pump-gun. When placed below work, device catches oil, chips, and cutoffs. Allows an endless stream of clean oil on the dies. More than 95 percent of the oil is saved and used again. THE RIDGE TOOL COMPANY.

717-Boiler with balanced feed

Balanced feed has now been applied to a completely automatic, forced-circulation-type boiler. With balanced feed, cold water entering the system is never admitted directly to the coils. Instead, as steam is taken off and hot water in the accumulator drops to a fixed level, an automatic control admits unheated feedwater. Feedwater temperature is quickly increased. This encourages precipitation of solids so that operating efficiency is increased and scaling is avoided. CLAYTON MANUFACTURING COMPANY.



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718-Indicating dry air breathers

Inexpensive method of reducing moisture content of atmospheric air entering storage tanks consists of breather with an all-brass housing screwed into tank top. Housing contains a transparent drying chamber filled with an indicating chemical drying agent that changes color as moisture is absorbed. The colored chemical indicates when reactivation is required. Reactivation consists of heating until original color returns. THE MCINTIRE COMPANY.

special report on control valves, positioners

Copies of INDUSTRY & POWER's Special Report on Control Valves and Positioners are still being made available in response to continuing demand. Intelligent valve selection is the theme of the Report, and all material in it is aimed at helping you get the most out of your valve dollars. Many illustrations accompany the text.

Individual copies of the Special Report on Control Valves and Positioners are free. Additional copies are priced as follows: 2 to 24 copies are 25c each; 25 to 49 copies are 20c each; 50 to 99 copies are 15c each; more than 99 copies are 10c each. Send all orders to

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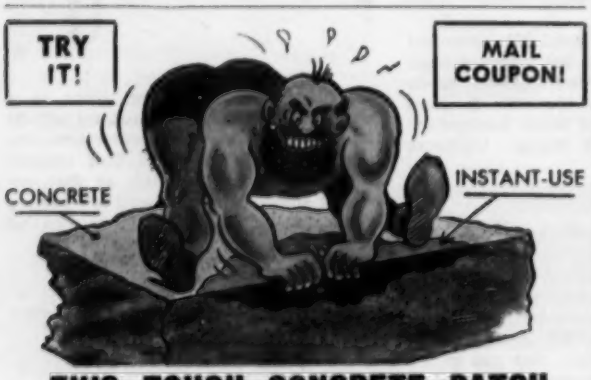

THIS TOUGH CONCRETE PATCH SETS INSTANTLY!

Repair broken factory floors without the usual traffic tie-up. Simply shovel INSTANT-USE into hole or rut — tamp smooth — truck over! No waiting! INSTANT-USE bonds tight to old concrete . . . right up to a feather edge. It's tough. Wears like iron. Won't crack or crumble. Install complete overlay where floors are badly chewed up. Used indoors or out. Immediate shipment.

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Please send me complete INSTANT-USE information, details of TRIAL ORDER PLAN and Free INSTANT-USE BROCHURE — no obligation. (Clip and attach Coupon to Co. letterhead).

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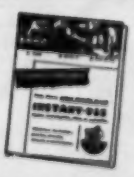

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NO Reducing Valve Needed

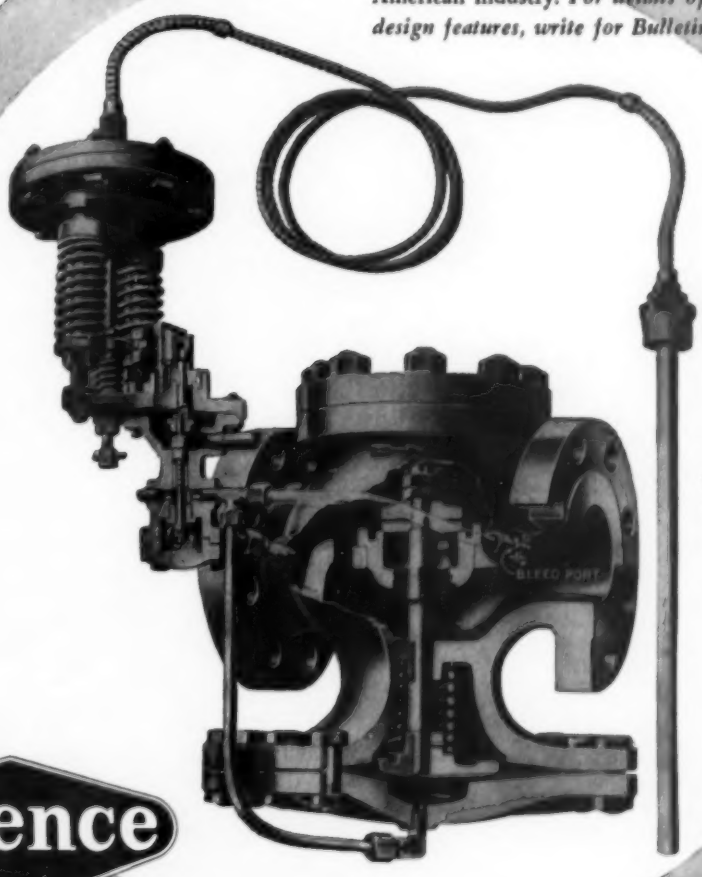
Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*



SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

GE-129

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Cool savings for Hotpoint...

For the past five years, Hotpoint Co., Milwaukee, has been using *Texaco Regal Oil R&O* for all its turbine lubrication. And here's what L. E. Sweet, Plant Manager, has to say about it:

> **"Texaco Regal Oil R&O has done a consistently fine job for us. It keeps our turbine blower systems exceptionally clean — no sludge, no rust, no foam. The oil stands up in severe service, bearing temperatures are always normal and governor response always immediate."**

Texaco Regal Oil R&O is a premium-quality oil. Special refining and effective additives *improve* its naturally fine properties, give it an extra long service life and enhance its ability to resist oxidation and prevent sludge, rust and foam.

There is a complete line of *Texaco Regal Oils R&O*. All meet the stringent requirements of leading turbine builders. A Texaco Lubrication Engineer will gladly help you select the proper one. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

HOTPOINT'S GOLDEN ANNIVERSARY is being celebrated this year and Texaco salutes this "Pioneer of the All-Electric Kitchen." We are proud that Texaco Lubricants and Lubrication Engineering Service are so widely used to help speed production of the famous Hotpoint kitchen and laundry appliances.

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

TUNE IN . . . TEXACO STAR THEATER starring JIMMY DURANTE on television . . . Saturday nights, NBC.

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